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For: NETWORK-DEVICE CONTROL SYSTEM AND APPARATUS

Enclosed are:

19 sheets of drawings.(Figs. 1,2,3A,3B,4A-4C,5-8,9A-9C,10,11,12A-12C,13,14,15A-15C,16-18, 19A,19B,20)

Specification, including claims and abstract (89 pages)

Declaration

An assignment of the Invention to FUJITSU LIMITED

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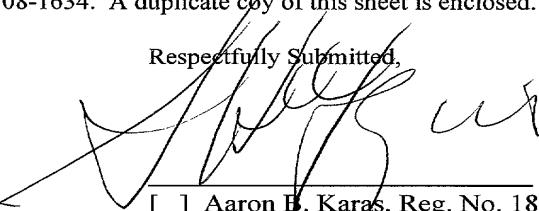
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SPECIFICATION

TITLE OF THE INVENTION

NETWORK-DEVICE CONTROL SYSTEM AND APPARATUS

BACKGROUND OF THE INVENTION

5 This invention relates to a system and apparatus for controlling network devices. More particularly, the invention relates to a network-device control system and apparatus for performing control of priority, bandwidth, discard rate and delay in relation the devices that
10 construct a network.

The following functions and features (1) to (3) are currently sought as network requirements:

(1) Quality assurance

Unification of continuous traffic, such as

15 telephone traffic that is sensitive to delay, and basic business traffic with an IP (Internet Protocol) network of superior cost performance is sought. However, the basic nature of an IP network is best-effort transport of IP packets. In such a best-effort transport
20 environment, an effort is made only to transport arriving packets to the next stage without distinguishing among users or among applications.

Packets that cannot be transported (i.e., packets for which buffer overflow has occurred) are discarded as is.

25 Accordingly, in order for a best-effort IP network to accommodate delay-sensitive traffic, it is required that control of traffic priority and assurance of bandwidth based upon the user or application is introduced in an

IP network.

(2) Minimum modification of existing network devices

Replacing terminal devices and network devices

5 (routers, switches, etc.) and installing new software in these devices in order to assure bandwidth and control priority on a network raises the cost of introduction and, hence, is a hindrance to such introduction.

Minimizing the modification of existing devices is
10 required in order to solve this problem.

(3) Quality and priority control capable of dealing with dynamic modification of terminal devices and network devices

Among all devices that construct a network, it will
15 suffice to apply quality and priority control solely to end-to-end devices on the communication path. This communication path is decided in accordance with a predetermined routing protocol based upon the destination address with which communication is
20 performed and the terminal address of the accessing party. However, the destination address and terminal address change constantly depending upon the location of the user and the application utilized. A dynamic quality and priority control method that can deal with
25 such change is sought.

The following two methods have been contemplated for the purpose of performing quality assurance control such as control for assurance of bandwidth or control of

priority.

The first method involves statically configuring network devices for the purpose of quality-assurance control. Specifically, control of communication quality

5 with respect to terminal-to-terminal communication is performed by configuring the network devices before hand so that predetermined bandwidth assurance and priority control is attained. This is the most widely utilized approach at present. In order to configure for

10 bandwidth assurance and priority control (i.e., in order to establish control of quality), there are two methods, namely (a) a method referred to as limited configuration method which includes predicting communication that will occur and configuring network devices on this

15 communication path for control of quality in limited fashion, and (b) a method which includes configuring all configurable network devices for control of quality comprehensively without particularly specifying a path.

The second method uses an RSVP (Resource

20 Reservation Protocol) for which control of quality can be configured dynamically. RSVP is a control protocol for reserving resources in the IP layer. According to RSVP, control messages are exchanged between routers that support RSVP and the sender and receiver. The RSVP

25 works to reserve transmission paths and memory resources within an apparatus so that an application can be executed. Fig. 20 is a diagram useful in describing RSVP. A sender 1 sends a receiver 2 a path message that

describes the traffic characteristics of the information (content) to be transmitted. The path message is distributed to the receiver 2 by being transferred along a path (routers 3, 4) set up by a predetermined routing

5 protocol. The receiver 2 refers to the content described in the path message and sends a reserve message, which describes the resources requiring reservation, back to the sender 1. If reservation requests from a plurality of receivers are merged and

10 acceptance of a requested bandwidth reservation is possible in a router along the path, bandwidth is secured in accordance with the content of the reservation request and a reserve message is transferred to a router upstream and to the sender 1. If acceptance

15 of a requested bandwidth reservation is impossible, however, the reserve message is discarded and an error message is transmitted to the receiver 1.

The second method based upon RSVP described above makes it possible to control quality dynamically when

20 the user so desires.

However, the first and second methods set forth above do not always satisfy the above-mentioned requirements (1), (2) and (3).

If communication different from that predicted in

25 advance takes place, as when a user makes access from a terminal different from that configured beforehand or when a network device is added on anew, the limited configuration technique according to the first method is

such that static quality-control settings will not exist for such communication. This means that the required control of quality cannot be performed. In other words, with the limited configuration method, changes in 5 conditions cannot be dealt with and, as a result, control of quality cannot be realized.

With the other technique available in accordance with the first method, namely the technique through which all configurable network devices are configured 10 for quality control, the user can make access from any terminal whatsoever because all of the terminals will have been configured. However, since settings that support all communication patterns are required for all network devices, the storage area necessary in a network 15 device for the purpose of storing these settings is enormous. (The size of the storage area is proportional to the square of the number of terminals.) Since a network device possesses only a limited storage area, such comprehensive configuring of network devices is 20 difficult. The result is that network communication assumed beforehand undergoes limited configuration.

With the second method, it is assumed that both sending and receive terminals involved in communication and all network devices (routers) on the path along 25 which this communication takes place support RSVP. Consequently, if a network device that does not support RSVP exists in the network, this device cannot undergo any control of quality. If congestion occurs in regard

to this network device, even a packet in communication requiring control of quality will be discarded or delayed. The end result is that communication quality cannot be controlled. In order to avoid this problem, 5 components which support RSVP are required for all network devices and it is necessary to increase the storage area and processing capability of each network device.

SUMMARY OF THE INVENTION

10 Accordingly, an object of the present invention is to arrange it so that priority control and quality control (control of bandwidth, discard rate and delay) can be carried out even if there is a change in a terminal employed by a user or a change in network 15 configuration due to the addition of a network device.

Another object of the present invention is to arrange it so that priority control and quality control can be performed, without dependence upon a specific protocol such as RSVP, even if there is a change in a 20 terminal employed by a user or a change in network configuration due to the addition of a network device.

Another object of the present invention is to arrange it so that communication can be performed between a terminal employed by a user and a server, 25 which is the destination of communication, at a priority or quality set for the user in advance.

A further object of the present invention is to arrange it so that communication can be performed

between a user terminal that has launched an application and a server, which is the destination of communication, at a priority or quality set for the application in advance.

5 (a) First network-device control system of the present invention

A first network-device control system according to the present invention includes (1) an event notification device for detecting that a user has logged in to a 10 communication terminal or that a user has launched a predetermined application from a communication terminal, and giving notification of an identifier of the user and of the fact that an event has occurred, and (2) a network-device controller for performing priority 15 control of a network device based upon information of which notification has been given by the event notification device. The network-device controller acquires the priority of the user indicated by the user identifier of which notification has been given by the 20 event notification device, obtains a network device on a communication path between the communication terminal employed by the user and a server which is the destination of communication, generates information necessary to perform priority control in accordance with 25 user priority, and sets this priority control information in each network device (routers, etc.) on the communication path.

In the first network-device control system

described above, the event notification device includes
(1) an event detector for detecting that a user has
logged in to a communication terminal or that a user has
launched an application from a communication terminal,
5 and (2) an event notifier for notifying the network-
device controller at least of the fact that the event
occurred and of the user identifier. Further, the
network-device controller includes (1) an event receiver
for receiving notification from the event notifier, (2)
10 a priority acquisition unit for acquiring the priority
of a user indicated by a received user identifier, (3) a
device selector for selecting a network device which is
subjected to priority control based upon the priority of
the user, (4) a device-specific information acquisition
15 unit for acquiring state of configuration of the network
device and a method of configuring the device, (5) a
configuration information generator for generating
priority-control configuration information for
performing priority control of each network device based
20 upon the acquired device-specific information and user
priority, and (6) a configuration information
transmitter for transmitting the priority-control
configuration information, which has been generated by
the configuration information generator, to the selected
25 network device to thereby set the information in this
network device.

In accordance with the first aspect of the
invention, a network device is obtained on a

communication path connecting a communication terminal employed by a user and a server that is the destination of communication, and priority control is performed upon setting priority information, which conforms to the

5 priority of the user, in this device. As a result, control of priority can be performed dynamically, without using a specific protocol such as RSVP, even if there is a change in a terminal used by a user or a change in network configuration, such as a change due to

10 the addition of a network device. Further, in accordance with the first aspect of the invention, communication between a terminal employed by a user and a server that is the destination of communication can be performed at a priority set for the user in advance. As

15 a result, by setting a priority that takes the section/department to which an employee belongs and organization into account in an enterprise network, it is possible to perform communication based upon priority control commensurate with the set priority.

20 Further, according to the first aspect of the invention, there is provided a database unit for storing, in association with a user identifier, user information that includes the address of the server that is the destination of communication and the user

25 priority. The event notification device acquires user priority and the server address from the database unit and reports these to the network-device controller. If this arrangement is adopted, the user, merely by

entering the user identifier from a communication terminal and logging in, establishes a communication path between this communication terminal and the server with which the user wishes to communicate.

5 Communication between the terminal employed by the user and the server can be performed at the priority set for the user beforehand.

Further, when an application is launched after user log-in, the priority control mentioned above can be

10 carried out. If this arrangement is adopted, the configuring of priority control necessary for the user in a network is performed more accurately by taking launching of an application by the user as an event.

When priority control is necessary, such control can be
15 configured solely for the necessary network device.

(b) Second network-device control system of the present invention

A second network-device control system according to the present invention includes (1) an event notification device for detecting that a user has launched a predetermined application from a communication terminal, and giving notification of an identifier of this application and of the fact that application-launch event has occurred, and (2) a network-device controller for performing priority control of a network device based upon information of which notification has been given. The network-device controller acquires the priority of the application indicated by the application

identifier of which notification has been given by the event notification device, obtains a network device on a communication path between the communication terminal and a server with which the communication terminal

5 communicates, generates information necessary to perform priority control in accordance with this priority, and configures each network device with this priority control information.

In the second network-device control system

10 described above, the event notification device includes
(1) an event detector for detecting that a communication
terminal has given rise to an application-launch event,
and (2) an event notifier for notifying the network-
device controller at least of the fact that the event
15 occurred and of the application identifier. Further,
the network-device controller includes (1) an event
receiver for receiving notification from the event
notifier, (2) a priority acquisition unit for acquiring
the priority of an application indicated by a received
20 application identifier, (3) a device selector for
selecting a network device which is subjected to
priority control based upon the priority of the
application, (4) a device-specific information
acquisition unit for acquiring state of configuration of
25 the selected network device and a method of configuring
the device, (5) a configuration information generator
for generating priority-control configuration
information for performing priority control of each

network device based upon the acquired device-specific information and application priority, and (6) a configuration information transmitter for transmitting the priority-control configuration information, which

5 has been generated by the configuration information generator, to the selected network device to thereby set this information in this network device.

In accordance with the second aspect of the invention, a network device is obtained on a

10 communication path connecting a communication terminal employed by a user and a server that is the destination of communication, and priority control is performed upon setting priority information, which conforms to the priority of the launched application, in this device.

15 As a result, control of priority can be performed dynamically, without using a specific protocol such as RSVP, even there is a change in a terminal used by a user or a change in network configuration, such as a change due to the addition of a network device. As a

20 result, by configuring priorities for various applications in an enterprise network upon taking into account the urgency and importance of these applications, it is possible to perform communication based upon priority control commensurate with the set

25 priority.

Further, according to the second aspect of the invention, the event notification device acquires the priority of the application, the address of the server

that is the destination of communication and the address of the communicating terminal from a database unit based upon the application identifier and reports these to the network-device controller. If this arrangement is

5 adopted, the user, merely by entering the user identifier from a prescribed communication terminal, logging in and launching the prescribed application, can set up a communication path between this communication terminal and the server that conforms to the

10 application. And communication between the terminal employed by the user and the server can be performed at the priority set for the application beforehand.

(c) Third network-device control system of the present invention

15 In the first and second network-device control systems according to the present invention, priority is set in advance in conformity with the user or application and priority control is performed in accordance with the priority of the user or the priority 20 of the application.

In the third network-device control system according to the present invention, a value of bandwidth, discard rate or delay time instead of priority is configured for a user or application and 25 bandwidth control, discard-rate control or delay control is carried out in accordance with the configured value on a communication path between the terminal employed by the user and the communicating server. The

configuration of the network-device control system in accordance with the third aspect of the present invention is substantially similar to that of the first and second aspects of the invention.

5 In accordance with the third aspect of the present invention, quality control can be performed dynamically, without using a particular protocol, even if there is a change in a terminal used by a user or a change in network configuration due to the addition of a network
10 device. Further, the terminal employed by the user and the server that is the destination of communication can communicate at a quality set in advance for the user or application.

Other features and advantages of the present
15 invention will be apparent from the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram useful in describing an
20 overview of the present invention;

Fig. 2 is a diagram showing an example of the configuration of a network according to a first embodiment of the present invention;

Figs. 3A and 3B are diagrams showing an example of
25 information that has been stored in a directory server according to the first embodiment;

Figs. 4A, 4B and 4C are diagrams useful in describing the topology of network devices;

Fig. 5 is a diagram showing an example of router information that has been stored in a directory server;

Fig. 6 is a diagram useful in describing priority control;

5 Fig. 7 is a diagram useful in describing a sequence according to a first embodiment of the present invention;

Fig. 8 is a diagram showing an example of the configuration of a network according to a second 10 embodiment of the present invention;

Figs. 9A, 9B and 9C are diagrams showing an example of information that has been stored in a directory server according to the second embodiment;

15 Fig. 10 is a diagram useful in describing a sequence according to a second example of the present invention;

Fig. 11 is a diagram showing an example of the configuration of a network according to a third embodiment of the present invention;

20 Figs. 12A, 12B and 12C are diagrams showing an example of information that has been stored in a directory server according to the third embodiment;

Fig. 13 is a diagram useful in describing a sequence according to a third example of the present 25 invention;

Fig. 14 is a diagram showing an example of the configuration of a network according to a fourth embodiment of the present invention;

Figs. 15A, 15B and 15C are diagrams showing example of information that has been stored in a directory server according to the third embodiment;

Fig. 16 is a diagram useful in describing a
5 sequence according to a fourth example of the present invention;

Fig. 17 is a diagram showing another example of information that has been stored in a directory server;

Fig. 18 is a diagram useful in describing a
10 bandwidth control sequence based upon occurrence of a log-in event;

Figs. 19A and 19B are diagrams showing an example of information that has been stored in a directory server for when bandwidth control based upon a log-in
15 event is performed; and

Fig. 20 is a diagram useful in describing RSVP control.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

(A) Overview of the present invention
20 (a) Construction

Fig. 1 is a block diagram illustrating an overview of the present invention.

In Fig. 1, an event notification device A detects and reports the fact that a user has logged in from a
25 communication terminal C or that a user has launched a predetermined application on the communication terminal C. A network-device controller B performs priority control of a network device N based upon information

reported from the event notification device A.

The event notification device A includes an event detector A1 for detecting that a user has logged in from the communication terminal C or that a user has launched an application from a communication terminal, and an event notifier A2 for notifying the network-device controller B of the fact that an event occurred, the identifier of the user or the identifier of the application.

The network-device controller B includes an event receiver B1 for receiving notification from the event notifier A2; a configuration determination unit B2 for acquiring the priority of a user indicated by a received user identifier or the priority of an application indicated by a received application identifier, and determining whether it is necessary to configure for priority control; a device selector B3 for selecting a network device which is subjected to priority control based upon the priority acquired; a device-specific information acquisition unit B4 for acquiring the configured state of a selected network device and a method of configuring the device; a configuration information generator B5 for generating priority-control configuration information necessary for performing priority control of every each network device based upon the acquired device-specific information and priority; and a configuration information transmitter B6 for transmitting the priority-control configuration

information, which has been generated by the configuration information generator, to the selected network device N to thereby set this information in the network device.

5 (b) Overview of first embodiment

The first embodiment is such that when a user logs in from a communication terminal, the network-device controller takes the log-in as an event to configure priority-control information for a network device on the 10 communication path in accordance with a priority that has been set in advance for this user, thereby performing control of priority.

In a network having a device that records in memory the fact that a user has logged in from the 15 communication terminal C, the event detector A1 reads the recorded content of the memory periodically and compares this with the previous recorded content to monitor a change in the recorded content, i.e., the occurrence of log-in. Alternatively, the event detector 20 A1 monitors the occurrence of log-in by having the above-mentioned device notify it of the fact that the stored content has been updated.

Upon detecting log-in, the event detector A1 acquires the address of the communication terminal C, 25 the identifier of the user who has logged in and the event type (log-in in this case), and the event notifier A2 reports the acquired information to the network-device controller B as event information.

In the network-device controller B, the event receiver B1 receives the event information from the event notification device A and delivers it to the configuration determination unit B2. The latter

5 recognizes the fact that an event occurred at the communication terminal C and determines, based upon the type of event, whether configuring of priority control is required. If the configuring is required, the configuration determination unit B2 acquires information

10 (user priority) that has been set in advance for the user and decides that traffic at such time that the user utilizes the network is to be controlled in accordance with the acquired priority. Next, the configuration determination unit B2 notifies the device selector B3 of

15 the event information and of the fact that configuring of priority is necessary. The device selector B3 selects, among a number of network devices (routers, etc.) in the network, network devices on a communication path between the communication terminal C of the user and the server that is the destination of communication obtained from information that has been set in advance for this user. In other words, the network-device controller B selects network devices for which control of priority is required.

20 After the network devices have been selected, the device selector B3 adds address information of the devices for which the configuring of priority control is required onto the received information from the previous

stage and delivers the resulting information to the device-specific information acquisition unit B4. The latter acquires, for each device indicated by the delivered device addresses, a method of configuring

5 information for each device, configurable parameters and states of the devices, appends this information to the received information and delivers the resulting information to the configuration information generator B5. On the basis of the information received, the

10 configuration information generator B5 determines what kind of configuration content is required for what network device and through what method, generates, by using the user priority, configuration content (priority-control configuration information) for all

15 devices requiring configuring, and reports this information to the configuration information transmitter B6. On the basis of the priority-control configuration information and configuration method obtained from the configuration information generator B5, the

20 configuration information transmitter B6 transmits the priority-control information to all network devices N on the communication path that need to be configured, thereby configuring these network devices.

According to the first embodiment, the event

25 notification device A detects an event and, on the basis of the event, the network-device controller B dynamically configures the priority-control information for the network devices on the communication path. This

makes possible flexible control of priority that accommodates a change in the state of a network. In addition, it is possible to perform communication control that conforms to the priority that has been set 5 in advance for a user. Further, the protocol between a communication terminal (client), server and network device can be an already existing protocol. As a result, a network device or terminal need not be equipped with a special protocol in order to perform 10 priority control.

(c) Overview of second embodiment

The second embodiment is such that when a user launches an application after logging in from a communication terminal, the network-device controller 15 takes the launching of the application as an event to configure priority-control information for a network device on the communication path in accordance with a priority that has been set in advance for this user, thereby performing priority control. Therefore, unlike 20 the first embodiment in which the configuring of priority-control information is performed by taking log-in as an event, the second embodiment configures priority-control information by taking launching of an application after log-in as the event.

25 The event detector A1 monitors the launching of applications in a manner similar to that of the first embodiment. Upon detecting launching of an application, the event detector A1 acquires the address of the

communication terminal C that launched the application, the user identifier and the event type (launching of an application in this case), and the event notifier A2 reports the acquired information to the network-device controller B as event information.

In the network-device controller B, the event receiver B1 receives the event information from the event notification device A and delivers it to the configuration determination unit B2. As a result, the latter recognizes the fact that an event occurred at the communication terminal C and determines, based upon the type of event, whether configuring of priority control is required. If configuring is required, the configuration determination unit B2 acquires priority information that has been set in advance for the user and decides that traffic at such time that the application utilizes the network is to be controlled in accordance with the priority of the user. Next, the configuration determination unit B2 notifies the device selector B3 of the event information and of the fact that configuring of priority is necessary. Priority-control information is then configured for the network devices N on the communication path by control similar to that of the first embodiment.

According to the second embodiment, priority control is performed in accordance with a priority, which has been set in advance for the user, taking launching of an application after log-in as the event.

In comparison with the first embodiment, therefore, configuring of priority control in accordance with user priority can be performed more reliably solely for network devices necessary for communication.

5 (d) Overview of third embodiment

The third embodiment is such that when a user launches an application after logging in from a communication terminal, the network-device controller takes the launching of the application as an event to 10 configure priority-control information for a network device on the communication path in accordance with a priority that has been set in advance for this application, thereby performing priority control.

The event detector A1 monitors the launching of 15 applications in a manner similar to that of the first embodiment. Upon detecting launching of an application, the event detector A1 acquires the address of the communication terminal C that launched the application, the application identifier and the event type (launching 20 of an application in this case), and the event notifier A2 reports the acquired information to the network-device controller B as event information.

In the network-device controller B, the event receiver B1 receives the event information from the 25 event notification device A and delivers it to the configuration determination unit B2. As a result, the latter recognizes the fact that an event occurred at the communication terminal C and determines, based upon the

type of event, whether configuring of priority control is required. If configuring is required, the configuration determination unit B2 acquires information (priority) that has been set in advance for the launched 5 application and decides that traffic at such time that the application utilizes the network is to be controlled in accordance with the above-mentioned priority. Next, the configuration determination unit B2 notifies the device selector B3 of the event information and of the 10 fact that configuring of priority is necessary. The device selector B3 selects, among a number of network devices in the network, network devices on a communication path between the communication terminal C of the user and the server with which the application 15 communicates. In other words, the network-device controller B selects network devices for which control of priority is required.

After the network devices have been selected, the device selector B3 adds address information of the 20 devices for which the configuring of priority control is required onto the received information from the previous stage and delivers the resulting information to the device-specific information acquisition unit B4. The latter acquires, for each device indicated by the 25 delivered device addresses, a method of configuring information for each device, configurable parameters and states of the devices, appends this information to the received information and delivers the resulting

information to the configuration information generator B5. On the basis of the information received, the configuration information generator B5 determines what kind of configuration content is required for what 5 network device and through what method, generates, by using the application priority, configuration content (priority-control configuration information) for all devices requiring configuration, and reports this information to the configuration information transmitter 10 B6. On the basis of the priority-control configuration information and configuration method obtained from the configuration information generator B5, the configuration information transmitter B6 transmits the priority-control information to all network devices N 15 that need to be configured, thereby configuring these network devices.

Thus, the configuring of priority-control information needed to execute an application can be performed only for devices requiring priority control, 20 this being carried out taking launching of the application by the user as the event. Further, communication control conforming to a priority that has been set in advance for an application can be performed.

(e) Overview of fourth embodiment
25 The fourth embodiment is such that when a user launches an application after logging in from a communication terminal, the network-device controller takes the launching of the application as an event to

configure bandwidth, which is required by the application, for a network device on the communication path of the application in accordance with a communication-quality value (e.g., bandwidth) that has 5 been set in advance for this application, thereby performing bandwidth control of this network device.

The event detector A1 monitors the launching of applications in a manner similar to that of the first embodiment. Upon detecting launching of an application, 10 the event detector A1 acquires the address of the communication terminal C that launched the application, the application identifier and the event type (launching of an application in this case), and the event notifier A2 reports the acquired information to the network-device controller B as event information. 15

In the network-device controller B, the event receiver B1 receives the event information from the event notification device A and delivers it to the configuration determination unit B2. The latter 20 recognizes the fact that an event occurred at the communication terminal C and determines, based upon the type of event, whether configuring of bandwidth is required. If configuring is required, the configuration determination unit B2 acquires the communication-quality 25 value (bandwidth information) of this application and decides that communication is to be performed upon reserving the bandwidth required by this application at the time of communication. Next, the configuration

determination unit B2 notifies the device selector B3 of the event information and of the fact that configuring of bandwidth is necessary. The device selector B3 selects, among a number of network devices in the

5 network, network devices on a communication path between the communication terminal C of the user and the server with which this application communicates. In other words, the network-device controller B selects network devices for which configuring of bandwidth is required.

10 After the network devices have been selected, the device selector B3 adds address information of the devices for which the configuring of bandwidth is required onto the received information from the previous stage and delivers the resulting information to the

15 device-specific information acquisition unit B4. The latter acquires, for each device indicated by the delivered device addresses, a method of configuring information for each device, configurable parameters and states of the devices, appends this information to the

20 received information from the previous stage and delivers the resulting information to the configuration information generator B5. On the basis of the information received, the configuration information generator B5 determines what kind of configuration

25 content is required for what network device and through what method, generates configuration content (bandwidth-control information) for all devices for which bandwidth required by the application must be reserved, and

reports this information to the configuration information transmitter B6. On the basis of the bandwidth-control information and configuration method obtained from the configuration information generator 5 B5, the configuration information transmitter B6 transmits the bandwidth-control information to all network devices N that need to be configured, thereby configuring these network devices.

The foregoing is for a case where bandwidth 10 required by an application is configured as a communication-quality value. However, discard rate and delay time, etc., can also be configured in conformity with the application.

In accordance with the fourth embodiment, the 15 configuring of quality control such as bandwidth, discard rate and delay needed for an application can be performed in a network only for devices requiring configuring, this being carried out taking launching of the application by the user as the event.

20 (f) Overview of fifth embodiment

The fifth embodiment is such that when a user logs in from a communication terminal, the network-device controller takes log-in as an event to configure bandwidth required by a user for a network device on the 25 communication path in accordance with a communication-quality value (e.g., bandwidth) that has been set in advance for this user, thereby performing bandwidth control of this network device.

The event detector A1 monitors log-in in a manner similar to that of the first embodiment. Upon detecting log-in, the event detector A1 acquires the address of the communication terminal C, the identifier of the user 5 who logged in and the event type (log-in in this case), and the event notifier A2 reports the acquired information to the network-device controller B as event information.

In the network-device controller B, the event receiver B1 receives the event information from the event notification device A and delivers it to the configuration determination unit B2. The latter recognizes the fact that an event occurred at the communication terminal C and determines, based upon the type of event, whether configuring of bandwidth is required. If configuring is required, the configuration determination unit B2 refers to the communication-quality value (bandwidth information) that has been set in advance for this user and decides that communication is to be performed upon reserving the bandwidth required at the time of communication. Next, the configuration determination unit B2 notifies the device selector B3 of the event information and of the fact that configuring of bandwidth is necessary. The device selector B3 selects, among a number of network devices in the network, network devices on a communication path between the communication terminal C of the user and the communication-destination server obtained from

information that has been set in advance for this user. In other words, the network-device controller B selects network devices for which configuring of bandwidth is required.

- 5 After the network devices have been selected, the device selector B3 adds address information of the devices for which the configuring of bandwidth is required onto the received information from the previous stage and delivers the resulting information to the
- 10 device-specific information acquisition unit B4. The latter acquires, for each device indicated by the delivered device addresses, a method of configuring information for each device, configurable parameters and states of the devices, appends this information to the
- 15 received information from the previous stage and delivers the resulting information to the configuration information generator B5. On the basis of the information received, the configuration information generator B5 determines what kind of configuration
- 20 content is required for what network device and through what method, generates configuration content (bandwidth-control information) for all devices for which bandwidth required by the user must be reserved, and reports this information to the configuration information transmitter
- 25 B6. On the basis of the bandwidth-control information and configuration method obtained from the configuration information generator B5, the configuration information transmitter B6 transmits the bandwidth-control

information to all network devices N that need to be configured, thereby configuring these network devices.

The foregoing is for a case where bandwidth required by an user is configured as a communication-5 quality value. However, discard rate and delay time, etc., can also be configured in conformity with the user.

In accordance with the fifth embodiment, the 10 configuring of quality control such as bandwidth, discard rate and delay needed for a user can be performed in a network only for devices requiring 15 configuring, this being carried out taking user log-in as the event.

(B) First embodiment

15 (a) Configuration

Fig. 2 is a diagram showing an example of the 20 configuration of a network according to a first embodiment of the present invention. Shown in Fig. 2 are a client 11 (end terminal) such as a personal computer; a server 12 having a function for storing data for a prescribed application, such as management application data and personnel application data, and distributing the data to clients; networks 13₁ to 13₃; routers 14₁, 14₂ for connecting these networks; switches 25 (exchanges) 15₁ to 15₄ provided in the networks; a directory server 16 having a database for storing user information on a per-user (e.g., employee) basis; an event notifier 17 for detecting a log-in event and

reporting event information; and a configuration server 18 which uses log-in as an event to configure the priority, which has been set for the user, for the network devices 15₁, 14₁, 15₃, 14₂, 15₄ on a 5 communication path CPT.

Fig. 2 illustrates an example of a network configuration for when the client 11 accesses the server 12. This assumes a situation where the client 11 accesses the server 12 via a network composed of various 10 routers and switches and either receives information that has been stored in the server 12 from the server 12 or transmits information to the server 12 to store the data in the server 12. In order to avoid a delay in receiving time or transmitting time and the discarding 15 of information owing to the effects of other traffic within the network at the time of such communication, each router traversed by desired traffic provides a service through which packets are transported at a priority higher than that of other traffic. A method of 20 applying the present invention in such case will be described below.

(b) Functions of components

The network according to the first embodiment is composed of the client 11, the server 12, the directory 25 server 16, the event notifier 17 and the configuration server 18. The directory server 16, a Lightweight Directory Access Protocol (LDAP) for accessing this directory server, and the function through which the

client 11 gives notification of log-in by LDAP
constitute prior art.

(b-1) Client

The client 11 in this embodiment is an end terminal
5 such as a personal computer. The client 11 is connected
to the network. If a user logs in this client, user
information (the user identifier) is reported to the
directory server 16 using LDAP. More specifically, when
the user logs in by entering a user identifier or
10 password, etc., from the client 11, the latter reports
the user identifier and its own IP address to the
directory server 16 by LDAP.

(b-2) Directory server

The directory server 16 manages, in the form of a
15 database, information relating to users who log in from
each client. As shown in Fig. 3A, the directory server
16 retains, in a form corresponding to each user
identifier, (1) the IP address of an important server
accessed in dedicated fashion by the user, (2) priority
20 when the user utilizes the network, and (3) other user-
specific information. For example, if the network is
one constructed within an enterprise, the following will
be stored in the database of the directory server 16 in
correspondence with user identification of each employee
25 (i.e., employee number): (1) the IP address of an
important server accessed in dedicated fashion by the
employee for business-related reasons, (2) priority when
the employee utilizes the network, (3) other specific

information. Important servers accessed in dedicated fashion by an employee for business-related reasons correspond in one-to-one fashion to the section to which the employee belongs (accounting department, personnel 5 department, planning department, patent department, technical department, etc.). Priority for utilizing a server is decided in dependence upon organization (person in charge, manager, section chief, department chief, etc.). Accordingly, the address of the important 10 server and the priority are set in advance taking the post of the employee and the organization into account, and these are registered in the database.

The client 11 accesses the directory server 16 using LDAP. More specifically, the client executes 15 database processing in regard to the user information using LDAP (the processing including responding to inquiries, updating information and creating of information). When a user logs in by inputting the user identifier from the client 11, the latter reports the 20 user identifier and the IP address of the client to the directory server 16. Upon receiving the identifier and IP address, the directory server 16 registers the IP address of the client in the database in correspondence with the above-mentioned user identifier, as shown in 25 Fig. 3B.

For example, as shown in Fig. 3A, (1) 192.168.20.30 (= IPs) has been registered beforehand in the database of the directory server 16 and (2) 8 has been registered

as the priority in the database of directory server 16 in correspondence with a user identifier "fujitsu". If user A logs in by inputting the user identifier "fujitsu" from the client 11 under these conditions, the 5 IP address 192.168.10.20 (IPc) of the client 11 is registered in the database anew as the user-specific information of user A, as shown in Fig. 3B.

(b-3) Event notifier

The event notifier 17 has a function for notifying 10 the configuration server 18 of any change that has occurred on the network and of the status of the network. Though the event notifier 17 is shown as being separate from the directory server 16 in Fig. 2, it is actually provided within the directory server 16. The 15 event notifier 17 monitors a change in a prescribed item of each user in the database of the directory server 16 from a logged-off state (a state in which there is no record of a logged-in client) to a logged-in state (a state in which there is a record of a logged-in client) 20 and, if a change has occurred, notifies the configuration server 18 of (1) the user identifier for which the change has occurred, (2) the IP address of the client who has logged in, and (3) the fact that an event has occurred due to log-in (i.e., the type of event). 25

The monitoring of a change in prescribed items in the database can be implemented by having the event notifier 17 read out the database information of the directory server 16 periodically and compare the

information with that read out previously.

(b-4) Configuration server

The configuration server 18 has the following functions (1) to (4):

5 (1) Upon receiving notification of the user log-in event from the event notifier 17, the configuration server 18 uses the user identifier as a key to query the directory server 16 as to the IP address of the important server utilized by the user and the priority
10 of the user and obtains responses regarding the IP address and user priority.

15 (2) Next, using IP routing information from the IP address of the client 11 and the IP address of the server 12, the configuration server 18 specifies the routers 14₁, 14₂ and the switches 15₁, 15₃, 15₄ that relay the sent and received traffic that occurs between the client 11 and the server 12. More specifically, the configuration server 18 identifies the network devices on the communication path CPT between the client 11 and server 12. This identification processing performed by the relaying routers is executed as follows: If the network is one which uses OSPF (Open Shortest Path First) as the IP routing protocol, the configuration server 18 receives an OSPF LSA (Link State
20 Advertisement) packet that has been broadcast within the network. The LSA packet contains topology information indicating the router connection relationship. When the LSA packet is received, therefore, the router topology
25

can be ascertained. On the basis of this topology information, the shortest path is calculated from the known IP addresses of the client 11 and server 12 using the Dijkstra algorithm and, hence, the IP routing information is obtained. The configuration server 18 is capable of obtaining the path between the client and server through this procedure. That is, the configuration server 18 is capable of identifying the relaying routers.

Figs. 4A to 4C are diagrams useful in describing the router topology information. In a case where routers A to E are connected as shown in Fig. 4C, the topology information of router A is a list of IP addresses of the adjacent routers, as shown in Fig. 4A, and the topology information of router B is a list of IP addresses of the adjacent routers, as shown in Fig. 4B. In other words, Fig. 4A expresses the fact that router A having the IP address 192.168.15.1 has been connected to the three routers B, C and D. In regard to router B having the IP address 192.168.10.1 among these three routers, it is indicated that there are two adjacent routers, namely routers A and E, as shown in Fig. 4B. Thus, a list of other routers to which a certain router is connected is expressed as one table and these tables are prepared in a number equivalent to the number of nodes, thereby expressing the topology of the network.

(3) The configuration server 18 acquires information relating to each router (the states of the

routers and configuration items) from the obtained IP addresses of the relaying routers. The states and configuration items are, e.g., configurable parameters, parameters that have already been configured, protocols 5 utilized in configuring and the methods of configuration.

These items of information may be applied to the configuration server 18 in advance, or each router may be inquired about them using a protocol such as SNMP 10 (Simple Network Management Protocol), or they may be registered together with user information as one item of network-device information (router information) and obtained by querying the directory server 16 using LDAP with the IP address of the router serving as a key. For 15 example, the fact that logging in to a router is performed by Telnet, the fact that a determined ID and password are necessary, and the fact that it is possible to make various settings and obtain information by execution of commands are stipulated by the router 20 information.

Fig. 5 illustrates an example of a case where router information has been stored in the directory server 16. The attributes of the router A are stored in the form of a sub-tree of a tree structure. The 25 attributes are the IP address of the router, the queue control scheme (the name "priority" is entered here and signifies a priority control scheme), the number (two) of queues, the configuration protocol (Telnet in this

example) and the names (Queue 1, Queue 2) assigned to the respective queues. This illustrates a case in which priorities 1, 2 have been entered for the queues.

Fig. 6 is a diagram useful in describing a priority control scheme for a router. The scheme includes the queue 1 of priority 1 (the highest priority), the queue 2 of priority 2 (the lowest priority), an allocation unit 3 for allocating input packets to the queues 1, 2, and a readout controller 4 for reading packets out of the queue 1 of highest priority in the order of arrival, outputting the packets to a line and, only when no packets are present in the queue of highest priority, for reading packets out of the queue 2 of lowest priority in the order of arrival and outputting the packets to the line. In order to subject a prescribed packet to high-priority processing, the fact that the packet is to be processed at the high priority is set in the allocation unit 3 together with the packet identification data. In response, from among the arriving packets, the allocation unit 3 inputs the packet having the above-mentioned identification data to the high-priority queue 1 so that the packet is subjected to high-priority processing.

(4) On the basis of the priority of the user, the configuration server 18 obtains a priority control parameter to configure the network device. For example, if the user priority entered from the directory server 16 is 8 and a router can be set to only two, namely high

and low, priorities, the configuration server 18 determines whether the user priority of 8 is the high or low priority and, if it is the high priority, configures the router to the high priority.

5 By repeating the above configuring for each router, the configuring of the priority of all routers on the communication path from the client 11 to the server 12 will eventually be completed and, as a result, it will be possible to provide a service for communicating 10 traffic between the client and server at a priority higher than that of other traffic.

 (c) Priority configuration sequence

Fig. 7 is a diagram useful in describing a priority configuration sequence according to the first 15 embodiment. This illustrates a case in which when the user has logged in from the client 11, the configuration server 18 uses log-in as an event to perform control of priority by configuring the routers 14₁, 14₂ on the communication path with priority control information in 20 accordance with a priority set in advance for this user.

I. When the user having the user identifier "fujitsu" logs in to the communication terminal (client) 11 having the IP address 192.169.10.20 (= IP_c), the client 11 sends the directory server 16 an LDAP message 25 for updating the information concerning the user identifier "fujitsu". The LDAP message contains the user identifier "fujitsu" and the IP address of the client. The directory server 16 registers the IP

address of the client in association with the user identifier "fujitsu" in the database (see Fig. 3B).

II. The event notifier 17 within the directory server 16 detects log-in and notifies the configuration server 18 of the fact that a user having the user identifier "fujitsu" has logged in to the client 11 having the IP address IPc.

III. The configuration server 18 queries the directory server in regard to the priority of the user 10 by LDAP using the user identifier "fujitsu" as the key and obtains, as a response, the fact that the address of the server 12 is 192.168.20.30 (= IPs) and that the priority is 8.

IV. Next, on the basis of OSPF information, the 15 configuration server 18 finds a router that relays the communication between the client 11 and the server 12. Assume that the IP address of the one router 14₁ is "192.168.15.1 (= IPr)".

V. The configuration server 18 obtains the state 20 of the router 14₁ and information (Fig. 5) relating to the configuration items. As a result, the router 14₁ can be configured using Telnet and it is ascertained that this router possesses two priority settings, namely high and low.

VI. If the priority that has been assigned to the 25 user identifier "fujitsu" has a value of 8 (the maximum value being 10) among ten priority levels, the configuration server 18 recognizes that the router 14₁

is to be configured for high-priority processing. Next, the configuration server 18 performs Telnet communication for the router 14, of IP address IPr and establishes a high priority for communication for which 5 the IP address on the originating side is IPc and the IP address at the destination is IPs.

VII. The configuring of priority processing described above is performed for other routers as well.

(d) Modification

10 In the embodiment set forth above, a router on the communication path between the client and server is found using OSPF. However, the topology and IP communication path may be found based upon other routing protocol information such as RIP (Routing Information 15 Protocol) and a network management protocol such as SNMP may be used. Further, the client 11 may execute traceroute processing with regard to a destination IP address, thereby finding the IP address of a router on the communication path so that this information may be 20 acquired by the configuration server 18. With this method, the configuration server need not compute topology information and path.

According to the above-described embodiment, user information has been stored in the directory server. 25 However, the state of log-in can be managed also by using another database having a data management function.

With the foregoing embodiment, LDAP is utilized for

the delivery of user data. However, any protocol can be utilized as long as it is capable of acquiring data.

In the foregoing embodiment, the case assumed is one in which the priority of the user or the IP address 5 of an important server is obtained. In a case where these are not obtained, however, configuring need not be performed or a priority or IP address given beforehand may be set instead of these values.

Further, according to the foregoing embodiment, 10 only one important server exists. However, in a case where there are a plurality of servers, the above-described embodiment can be applied to each one.

Further, according to the foregoing embodiment, 15 configuring of priority is attempted for all relaying routers. However, the configuring of priority may be performed for a router decided in advance. The configuring of priority may be performed even for switches of a MAC (Media Access Control) layer in addition to relaying routers present on the 20 communication path.

Further, according to the foregoing embodiment, the 25 configuring of priority is carried out when an event occurs. However, the configuration server may periodically check for a change in path information or user information and, when such a change is detected, may cancel the original settings and then perform a reconfiguring operation, thereby making possible control of priority for dealing with a change in network

configuration or user information after settings have been made. Alternatively, the event detector may detect a change in user information and network configuration and notify the configuration server, in response to 5 which the configuration server may cancel the original setting and then perform a reconfiguring operation. Further, the monitoring of a change in a prescribed item in the database can be implemented by adding on an event detector as part of the function for writing data from 10 the directory server 16 to the database.

The modification set forth above can be applied to embodiments described below as well.

(C) Second embodiment

(a) Construction

15 Fig. 8 is a diagram illustrating an example of the construction of a second embodiment of the present invention. Components identical with those of the first embodiment shown in Fig. 2 are designated by like reference characters.

20 According to the second embodiment, the event notifier 17 performs monitoring to determine that the user has launched an application at an end terminal and the configuration server 18 performs configuration for control of priority based upon detection of launching of 25 the application (detection of an event). More specifically, the second embodiment differs from the first embodiment in terms of the monitoring function of the event notifier 17. Performing control of priority

at launching of an application following log-in, as is done in the second embodiment, is better than performing control of priority at the time of log-in, as is done in the first embodiment, for the purpose of configuring the 5 priority of a router in strict conformity with the case in which traffic is actually utilized.

As in the first embodiment, the network of this embodiment includes the client 11, the server 12, the directory server 16, the event notifier 17 and the 10 configuration server 18.

(b) Functions of components

(b-1) Client

The client 11 is an end terminal such as a personal computer and is connected to the network. If a user 15 logs in utilizing the client 11, user information (the user identifier) is reported to the directory server 16 using LDAP. More specifically, when the user logs in by entering a user identifier or password, etc., from the client 11, the latter reports the user identifier and 20 its own IP address to the directory server 16 by LDAP.

Similarly, if a certain user launches a prescribed application using the client 11, the latter registers the application information (the application identifier and the IP address of the server with which this 25 application communicates) in the directory server 16 using LDAP.

(b-2) Directory server

The directory server 16 manages, in the form of a

database, information relating to users and information relating to applications launched by users. More specifically, the directory server 16 retains, in the form of a database, (1) a user identifier, (2) the IP address of an end terminal at which the user has logged in, (3) the identifier of an application utilized by the user, (4) the IP address of the server with which this application communicates, and (5) the priority for when the user utilizes the network (see Fig. 9C). The client 11, which is an end terminal, accesses the directory server 16 using LDAP and subjects the user information to database processing (processing such as responding to inquiries, updating information and creating information). When a user has logged in or launched an application, the client 11 notifies the directory server 16 of the information relating to the user or of the information relating to the application.

As shown in Fig. 9A, (1) the priority for when the user utilizes the network and (2) other user-specific information have initially been registered in the database of directory server 16 in correspondence with a user identifier. If the user logs in by inputting the user identifier from the client 11 under these conditions, the client 11 notifies the directory server 16 of the user identifier and IP address of the client by LDAP. Upon receiving the identifier and IP address, the directory server 16 registers the IP address of the client in the database in correspondence with the above-

mentioned user identifier, as shown in Fig. 9B. For example, as shown in Fig. 9A, 8 has been registered as the priority in the database of directory server 16 in correspondence with the user identifier "fujitsu".

5 user A logs in by inputting the user identifier "fujitsu" from the client 11 under these conditions, the IP address 192.168.10.20 (= IPc) of the client 11 is registered in the database anew as the user-specific information of user A, as shown in Fig. 9B.

10 Similarly, if the user launches an application that utilizes an accounts database, the client 11 notifies the directory server 16 of the identifier "accounting" of the above-mentioned application and of the IP address "192.168.30.11 (= IPa)" of the accounts server 12, which 15 is the destination with which this application communicates, by LDAP. Upon being so notified, the directory server 16 registers the application identifier "accounting" and the IP address 192.168.30.11 (= IPa) in the database, as shown in Fig. 9C.

20 (b-3) Event notifier

The event notifier 17 has a function for notifying the configuration server 18 of any change that has occurred on the network and of the status of the network. Though the event notifier 17 is shown as being 25 separate from the directory server 16, it is actually provided within the directory server 16. The event notifier 17 monitors, on a per-user basis, a change in state from an application-inactive state (a state in

which an application identifier has not been registered
in the directory server) to an application-launched
state (a state in which an application identifier has
been registered in the directory server) and, if a
5 change has occurred, notifies the configuration server
18 of (1) the IP address IPc of the end terminal that
launched the application, (2) the identifier of the
launched application, (3) the IP address IPa of the
destination with which the application communicates, and
10 (4) the fact that an application-launch event has
occurred (i.e., the type of event).

The monitoring of a change in application
information in the database can be implemented by having
the event notifier 17 read out the database information
15 of the directory server 16 periodically and compare the
information with that read out previously.

(b-4) Configuration server

The configuration server 18 has the following
functions (1) to (4):

20 (1) Upon receiving notification of the
application-launch event from the event notifier 17, the
configuration server 18 uses the IP address of the end
terminal that launched this application as a key to
query the directory server 16 as to the priority of the
25 user who is utilizing the end terminal and obtains a
response regarding this inquiry. In this embodiment, a
response to the effect that the priority is 8 is
obtained when the directory server 16 is queried using

the IP address IP_c as the key.

It should be noted that an arrangement can be adopted in which the configuration server 18 has the event notifier 17 report the user identifier in addition 5 to the application information, uses this user identifier to query the directory server 16 with regard to the priority of the user who is utilizing the end terminal and acquires this priority.

(2) Next, through a method similar to that of the 10 first embodiment, the configuration server 18 uses the reported IP addresses of the client 11 and server 12 and the IP routing information to specify the routers 14₁, 14₂ and the switches 15₁, 15₃, 15₄ that relay the sent and received traffic that occurs between the client 11 15 and the server 12. More specifically, the configuration server 18 identifies the network devices on the communication path CPT between the client 11 and server 12.

(3) The configuration server 18 acquires 20 information relating to each router (the states of the routers and the configuration items) from the obtained IP addresses of the relaying routers 14₁, 14₂.

(4) On the basis of the router information and 25 priority of the user, the configuration server 18 generates a priority control parameter to configure the router and sets this parameter in the router. For example, if the user priority entered from the directory server 16 is 8 and a router can be set to only two,

namely high and low, priorities, the configuration server 18 determines whether the user priority of 8 is the high or low priority and, if it is the high priority, sets the router to the high priority.

5 By repeating the above configuring for each router, the configuring of the priority of all routers on the communication path from the client 11 to the server 12 will eventually be completed and, as a result, it will be possible to provide a service for communicating
10 traffic between the client and server at a priority higher than that of other traffic.

(c) Priority configuration sequence

Fig. 10 is a diagram useful in describing a priority configuration sequence according to the first embodiment. This illustrates a case in which when the user has logged in from the client 11 and then launched an application, the configuration server 18 uses launching of the application as an event to perform priority control by configuring the routers 14₁, 14₂ on
15 the communication path with priority control information in accordance with a priority set in advance for this user.

I. When the user having the user identifier "fujitsu" logs in to the communication terminal (client)
25 11 having the IP address 192.169.10.20 (= IP_c), the client 11 sends the directory server 16 an LDAP message for updating the information concerning the user identifier "fujitsu". Accordingly, the LDAP message

contains the user identifier "fujitsu" and the IP address of the client. The directory server 16 registers the IP address of the client in association with the user identifier "fujitsu" in the database (see 5 Fig. 9B).

II. When the user having the user identifier "fujitsu" launches a prescribed application at the client 11 having the IP address IPc, this client sends the directory server 16 an LDAP message in order to 10 register the application information in the directory server 16. The LDAP message contains, as application information, (1) the application identifier "accounting" launched by the user having the user identifier "fujitsu", and (2) the IP address 192.168.30.11 (= IPa) 15 of the server with which the application communicates. Accordingly, the directory server 16 registers the application identifier "accounting" and the IP address 192.168.30.11 (= IPa) of the server with which this application communicates in the database in association 20 with the user identifier "fujitsu" (see Fig. 9C).

III. If the event notifier 17 within the directory server 16 detects launching of the application, the event notifier 17 notifies the configuration server 18 of the fact that an application which has the 25 application identifier "accounting" and which communicates with a server having the IP address IPa has been launched at the client 11 having the IP address IPc.

IV. The configuration server 18 queries the directory server 16 in regard to the priority of the user by LDAP using the IP address (= IPc) of the communication terminal as the key and obtains, as a 5 response, the fact that the priority is 8.

V. Next, on the basis of OSPF information, the configuration server 18 finds a router that relays the communication between the client 11 and the server 12. Assume that the IP address of the one router 14₁ is 10 "192.168.15.1 (= IPr)".

VI. The configuration server 18 obtains the state of the router 14₁ and information (Fig. 5) relating to the configuration items. As a result, the router 14₁ can be configured using Telnet and it is ascertained 15 that this router possesses two priority settings, namely high and low.

VII. If the priority that has been assigned to the user identifier "fujitsu" has a value of 8 (the maximum value being 10) among ten priority levels, the 20 configuration server 18 recognizes that the router 14₁ is to be configured for high-priority processing. Next, the configuration server 18 performs Telnet communication for the router 14₁ of IP address IPr and establishes a high priority for communication for which 25 the IP address on the originating side is IPc and the IP address at the destination is IPs.

VIII. The configuring of priority processing described above is performed for other routers as well.

(D) Third embodiment

(a) Construction

Fig. 11 is a diagram illustrating an example of the construction of a third embodiment of the present invention. Components identical with those of the second embodiment shown in Fig. 8 are designated by like reference characters.

According to the third embodiment, the event notifier 17 performs monitoring to determine that an application has been launched at an end terminal and, on the basis of detection of application launch (event detection), the configuration server 18 configures priority for a router on the communication path of the application. In the second embodiment, configuring of priority is performed for a router by utilizing a priority that is decided for each user. In the third embodiment, however, configuring of priority is performed for a router by utilizing a priority that is decided for each application. In accordance with the third embodiment, priority control made to conform to the characteristics of the application becomes possible.

As in the first and second embodiments, the network according to the third embodiment includes the client 11, the server 12, the directory server 16, the event notifier 17 and the configuration server 18.

(b) Functions of components

(b-1) Client

The client 11 is an end terminal such as a personal

computer and is connected to the network. If a user logs in utilizing the client 11, user information (the user identifier) is registered in the directory server 16 using LDAP. More specifically, when the user logs in 5 by entering a user identifier or password, etc., from the client 11, the latter registers the user identifier and its own IP address in the directory server 16 by LDAP. Similarly, if a certain user launches a prescribed application using the client 11, the latter 10 registers the application information (the application identifier and the IP address of the server with which the application communicates) in the directory server 16 using LDAP.

It should be noted that if application priority and 15 the IP address of the communication-destination server of the application have been registered in the directory server 16 in association with the application identifier, the client need only register the application identifier in the directory server 16 as the 20 application information.

(b-2) Directory server

The directory server 16 manages, in the form of a database, information relating to users and information relating to applications launched by users. The user 25 information contains (1) the user identifier, (2) the IP address of the end terminal at which the user has logged in, (3) the identifier of the application utilized by the user, (4) the IP address of the server with which

this application communicates, and (5) other specific information (see Fig. 11C). Further, the application information contains (1) the application identifier and (2) the priority of the application. However, the 5 application information can include the IP address of the server with which the application communicates.

The client 11, which is an end terminal, accesses the directory server 16 using LDAP and subjects the user information to database processing (processing such as 10 responding to inquiries, updating information and creating information). When a user has logged in or launched an application, the client 11 notifies the directory server 16 of the information relating to the user or of the information relating to the application.

15 As shown in Fig. 12A, only user-specific information has initially been registered in the directory server 16 in correspondence with a user identifier. An application priority of 6 has been registered in correspondence with the application 20 identifier "accounting".

If the user logs in by inputting the user identifier from the client 11 under these conditions, the client 11 notifies the directory server 16 of the user identifier and IP address of the client by LDAP. 25 Upon receiving the identifier and IP address, the directory server 16 registers the IP address 192.168.10.20 (= IPc) of the client in correspondence with the above-mentioned user identifier, as shown in

Fig. 12B.

Similarly, if the user launches an application that utilizes an accounts database, for example, the client 11 notifies the directory server 16 of the identifier 5 "accounting" of the above-mentioned application and of the IP address "192.168.30.11 (= IPa)" of the accounts server 12, which is the destination with which this application communicates, by LDAP. Upon being so notified, the directory server 16 registers the 10 application identifier and the IP address of the server, which is the destination with which the application communicates, in the database, as shown in Fig. 12C.

(b-3) Event notifier

The event notifier 17 has a function for notifying 15 the configuration server 18 of any change that has occurred on the network and of the status of the network. Though the event notifier 17 is shown as being separate from the directory server 16, it is actually provided within the directory server 16. The event 20 notifier 17 monitors, on a per-user basis, a change in state from an application-inactive state to an application-launched state and, if a change has occurred, notifies the configuration server 18 of (1) the IP address IPc of the end terminal that launched the 25 application, (2) the identifier of the launched application, (3) the IP address IPa of the destination with which the application communicates, and (4) the fact that an application-launch event has occurred

(i.e., the type of event).

The monitoring of a change in application information in the database can be implemented by having the event notifier 17 read out the database information 5 of the directory server 16 periodically and compare the information with that read out previously.

(b-4) Configuration server

The configuration server 18 has the following functions (1) to (4):

10 (1) Upon receiving notification of the application-launch event from the event notifier 17, the configuration server 18 uses the application identifier contained in the event notification as a key to query the directory server 16 as to the priority, on the 15 network, of the application that has been launched at the end terminal, and obtains a response regarding this inquiry. In this embodiment, a response to the effect that the priority is 6 is obtained when the directory server 16 is queried using the application identifier 20 "accounting" as the key.

(2) Next, through a method similar to that of the first embodiment, the configuration server 18 uses the reported IP addresses of the client 11 and server 12 and the IP routing information to specify the routers 14₁, 14₂ and the switches 15₁, 15₃, 15₄ that relay the sent 25 and received traffic that occurs between the client 11 and the server 12. More specifically, the configuration server 18 identifies the network devices (routers and

switches) on the communication path CPT between the client 11 and server 12.

(3) The configuration server 18 acquires information relating to each router (the states of the 5 routers and the configuration items) from the obtained IP addresses of the relaying routers.

(4) On the basis of the router information and priority of the application, the configuration server 18 generates a priority control parameter to configure the 10 router and, using a setting protocol, sets this parameter in the router that relays the communication between the client and the server. By repeating the above configuring for each router, the configuring of the priority of all routers on the communication path 15 from the client 11 to the server 12 will eventually be completed and, as a result, it will be possible to provide a service for communicating traffic between the client and server at a priority higher than that of other traffic.

20 (c) Priority configuration sequence

Fig. 13 is a diagram useful in describing a priority configuration sequence according to the third embodiment. This illustrates a case in which when the user has logged in from the client 11 and then launched 25 an application, the configuration server 18 uses launching of the application as an event to perform priority control by configuring priority control information for the routers 14₁, 14₂ on the

communication path in accordance with a priority set in advance for this application.

I. When the user having the user identifier "fujitsu" logs in to the communication terminal (client) 5 11 having the IP address 192.169.10.20 (= IPc), the client 11 sends the directory server 16 an LDAP message for updating the information concerning the user identifier "fujitsu". The LDAP message contains the user identifier "fujitsu" and the IP address of the 10 client. Accordingly, the directory server 16 registers the IP address of the client in association with the user identifier "fujitsu" in the database (see Fig. 11B).

II. When the user having the user identifier "fujitsu" launches a prescribed application at the 15 client 11 having the IP address IPc, this client sends the directory server 16 an LDAP message in order to register the application information. The LDAP message contains, as application information, the application 20 identifier "accounting" launched by the user having the user identifier "fujitsu", and the IP address 192.168.30.11 (= IPa) of the server with which the application communicates. Accordingly, the directory server 16 registers the application identifier 25 "accounting" and the IP address 192.168.30.11 (= IPa) of the server with which this application communicates in the database in association with the user identifier "fujitsu" (see Fig. 12C).

III. If the event notifier 17 within the directory server 16 detects launching of the application, the event notifier 17 notifies the configuration server 18 of the fact that an application which has the 5 application identifier "accounting" and which communicates with a server having the IP address IPa has been launched at the client 11 having the IP address IPC.

IV. The configuration server 18 queries the 10 directory server 16 in regard to the priority of the application by LDAP using the application identifier "accounting" as the key and obtains, as a response, the fact that the priority is 6.

V. Next, on the basis of OSPF information, the 15 configuration server 18 finds a router that relays the communication between the client 11 and the server 12. Assume that the IP address of the one router 14₁ is "192.168.15.1 (= IPr)".

VI. The configuration server 18 obtains the state 20 of the router 14₁ and information relating to the configuration items. As a result, the router 14₁ can be configured using Telnet and the configuration server 18 can ascertain that this router possesses two priority settings, namely high and low.

25 VII. If the priority that has been assigned to the application has a value of 6 (the maximum value being 10) among ten priority levels, the configuration server 18 recognizes that the router IPr is to be configured

for high-priority processing. Next, the configuration server 18 performs Telnet communication for the router 141 of IP address IPr and establishes a high priority for communication for which the IP address on the 5 originating side is IPc and the IP address at the destination is IPa.

VIII. The configuring of priority processing described above is performed for other routers as well.

(E) Fourth embodiment

10 (a) Construction

Fig. 14 is a diagram illustrating an example of the construction of a fourth embodiment of the present invention. Components identical with those of the third embodiment shown in Fig. 11 are designated by like 15 reference characters. In the third embodiment, priority configuration for a router on the communication path of an application is performed based upon the priority of the application. In the fourth embodiment, however, bandwidth is configured for a router on the 20 communication path of an application based upon the bandwidth required by the application. In accordance with the fourth embodiment, it is possible to assure communication quality more reliably in comparison with priority control.

25 As in the first through third embodiments, the network according to the fourth embodiment includes the client 11, the server 12, the directory server 16, the event notifier 17 and the configuration server 18.

(b) Functions of components

(b-1) Client

The client 11 is an end terminal such as a personal computer and is connected to the network. If a user 5 logs in utilizing the client 11, user information (the user identifier) is registered in the directory server 16 using LDAP. More specifically, when the user logs in by entering a user identifier or password, etc., from the client 11, the latter registers the user identifier 10 and its own IP address in the directory server 16 by LDAP. Similarly, if a certain user launches a prescribed application using the client 11, the latter registers the application information (the application identifier and the IP address of the communication- 15 destination server of the application) in the directory server 16 using LDAP. Similarly, if a certain user launches a prescribed application using the client 11, the latter registers the application information (the application identifier and the IP address of the server 20 with which the application communicates) in the directory server 16 using LDAP.

(b-2) Directory server

The directory server 16 manages, in the form of a database, information relating to users and information 25 relating to applications launched by users. The user information contains (1) the user identifier, (2) the IP address of the end terminal at which the user has logged in, (3) the identifier of the application utilized by

the user, (4) the IP address of the server with which this application communicates, and (5) other specific information (see Fig. 15C). Further, the application information contains (1) the application identifier and 5 (2) the bandwidth required by the application. The application information can include the IP address of the server with which the application communicates.

The client 11, which is an end terminal, accesses the directory server 16 using LDAP and subjects the user 10 information to database processing (processing such as responding to inquiries, updating information and creation of information). When a user has logged in or launched an application, the client 11 notifies the directory server 16 of the information relating to the 15 user or of the information relating to the application.

As shown in Fig. 15A, only user-specific information has initially been registered in the directory server 16 in correspondence with a user identifier. A bandwidth of 1.5 Mbps required by the 20 application has been registered in correspondence with the application identifier "videoplayer". If the user logs in by inputting the user identifier "fujitsu" from the client 11 under these conditions, the client 11 notifies the directory server 16 of the user identifier 25 and IP address 192.168.10.20 (= IPc) of the client by LDAP. Upon receiving the user identifier and IP address, the directory server 16 registers the IP address IPc of the client in correspondence with the

above-mentioned user identifier, as shown in Fig. 15B.

Similarly, if the user launches an application for reproducing video, the client 11 notifies the directory server 16 of the identifier "videoplayer" of the above-mentioned application and of the IP address "192.168.30.11 (= IPa)" of the video server 12, which is the destination with which this application communicates, by LDAP. Upon being so notified, the directory server 16 registers the application identifier 10 "videoplayer" and the IP address (= IPa) of the video server, which is the destination with which the application communicates, in the user information field of the database, as shown in Fig. 15C.

(b-3) Event notifier

15 The event notifier 17 has a function for notifying the configuration server 18 of any change that has occurred on the network and of the status of the network. Though the event notifier 17 is shown as being separate from the directory server 16, it is actually 20 provided within the directory server 16. The event notifier 17 monitors, on a per-user basis, a change in state from an application-inactive state to an application-launched state and, if a change has occurred, notifies the configuration server 18 of (1) 25 the IP address IPc of the end terminal that launched the application, (2) the identifier of the launched application, (3) the IP address IPa of the destination with which the application communicates, and (4) an

event notifier "application", which indicates the fact that an application-launch event has occurred.

The monitoring of a change in application information in the database can be implemented by having 5 the event notifier 17 read out the database information of the directory server 16 periodically and compare the information with that read out previously.

(b-4) Configuration server

The configuration server 18 has the following 10 functions (1) to (4):

(1) Upon receiving notification of the application-launch event from the event notifier 17, the configuration server 18 decides, based upon the event identifier "application" contained in event 15 notification, whether to perform control for bandwidth reservation. If bandwidth control is to be performed, the configuration server 18 uses the application identifier contained in the event notification as a key to query the directory server 16 as to the bandwidth 20 required by the application that has been launched at the end terminal, and obtains the response "1.5 Mbps" regarding this inquiry. In this embodiment, a response to the effect that the bandwidth is 1.5 Mbps is obtained when the directory server 16 is queried using the 25 application identifier "videoplayer" as the key.

(2) Next, through a method similar to that of the first embodiment, the configuration server 18 uses the reported IP addresses of the client 11 and server 12 and

the IP routing information to specify the routers 14₁, 14₂ and the switches 15₁, 15₃, 15₄ that relay the sent and received traffic that occurs between the client 11 and the server 12. More specifically, the configuration 5 server 18 identifies the network devices (routers and switches) on the communication path CPT between the client 11 and server 12.

(3) The configuration server 18 acquires information relating to each router (the states of the 10 routers and the configuration items) from the obtained IP addresses of the relaying routers.

(4) On the basis of the router information and the bandwidth required by the application, the configuration server 18 generates a bandwidth control parameter to 15 configure the router and sets this parameter in the router that relays the communication between the client and the server. By repeating the above configuring for each router, the configuring of the bandwidth of all routers on the communication path from the client 11 to 20 the server 12 will eventually be completed. As a result, the bandwidth required by the application can be assured between the client and the server and communication can be performed at a high quality.

(c) Bandwidth configuration sequence
25 Fig. 16 is a diagram useful in describing a bandwidth configuration sequence according to the fourth embodiment. This illustrates a case in which when the user has logged in from the client 11 and then launched

an application, the configuration server 18 uses launching of the application as an event to perform bandwidth configuration control of the routers 141, 142 on the communication path in accordance with the 5 required bandwidth set in advance for this application.

I. When the user having the user identifier "fujitsu" logs in to the communication terminal (client) 11 having the IP address 192.169.10.20 (= IPc), the client 11 sends the directory server 16 an LDAP message 10 for updating the information concerning the user identifier "fujitsu". The LDAP message contains the user identifier "fujitsu" and the IP address of the client. Accordingly, the directory server 16 registers the IP address of the client in association with the 15 user identifier "fujitsu" in the database (see Fig. 15B).

II. When the user having the user identifier "fujitsu" launches a prescribed application at the client 11 having the IP address IPc, this client sends 20 the directory server 16 an LDAP message in order to register the application information. The LDAP message contains, as application information, the application identifier "videoplayer" for video reproduction launched by the user having the user identifier "fujitsu", and 25 the IP address 192.168.30.11 (= IPa) of the video server with which the application communicates. Accordingly, the directory server 16 registers the application identifier "videoplayer" and the IP address

192.168.30.11 (= IPa) of the server with which this application communicates in the database in association with the user identifier "fujitsu" (see Fig. 15C).

III. If the event notifier 17 within the directory server 16 detects launching of the application, the event notifier 17 notifies the configuration server 18 of the fact that an application which has the application identifier "videoplayer" and which communicates with a video server having the IP address IPa has been launched at the client 11 having the IP address IPc.

IV. The configuration server 18 queries, by LDAP, the directory server 16 in regard to the bandwidth required by the application using the application identifier "videoplayer" as the key and obtains, as a response, the fact that the required bandwidth is 1.5 Mbps.

V. Next, on the basis of OSPF information, the configuration server 18 finds a router that relays the communication between the client 11 and the server 12. Assume that the IP address of the one router 14₁ is "192.168.15.1 (= IPr)".

VI. The configuration server 18 obtains router information (state and information relating to the configuration items) concerning the router 14₁. As a result, the router 14₁ can be configured using Telnet and the configuration server 18 can ascertain that this router is capable of having its bandwidth configured.

VII. The configuration server 18 performs Telnet communication with respect to the router 14₁ of IP address IPr and performs configuring to allocate the bandwidth of 1.5 Mbps for communication for which the IP address on the originating side is IPc and the IP address at the destination is IPa.

VIII. The above-described allocating of bandwidth is performed for other routers as well.

(d) Modification

10 The fourth embodiment relates to a case where the bandwidth required by an application is registered beforehand in the application information field of the directory server 16, as shown in Fig. 15A, the bandwidth required by the application is obtained from this

15 registered data and is reported to the configuration server. However, it is not necessary to register the required bandwidth in advance. For example, an arrangement may be adopted in which when an application is launched, the required bandwidth is registered in the

20 user information field upon being sent to the directory server 16 along with the application identifier and IP address of the destination with which the application communicates. Fig. 17 illustrates an example of the database structure in directory server 16 in such case.

25 With this data structure, the configuration server 18 is capable of querying the directory server 16 in regard to required bandwidth using a combination of both the user identifier and application identifier as a key.

Further, though the foregoing relates to a case in which bandwidth is controlled, control of packet discard rate and control of delay can be executed in the same manner. Further, an arrangement can be adopted in which

5 two or more types of control such as control of bandwidth, control of discard rate and control of data, inclusive of control of priority, can be performed simultaneously.

Further, the foregoing relates to a case in which

10 bandwidth required by an application is set in advance and the bandwidth of a router is controlled, in response to launching of the application, based upon the bandwidth required by this application. However, an arrangement can be adopted in which required bandwidth

15 is set for every user in advance and bandwidth is controlled, in response to launching of an application, based upon the bandwidth required by the user.

Further, the foregoing relates to a case where bandwidth, discard rate and delay are controlled by

20 launching an application. However, an arrangement can be adopted in which bandwidth, discard rate and delay are controlled by generating a log-in event.

Fig. 18 is a diagram useful in describing a sequence in a case where allocation of bandwidth to a

25 router on a communication path is performed based upon bandwidth required by a user at occurrence of a log-in event, and Figs. 19A, 19B are diagrams showing the structure of the directory server 16. As shown in Fig.

19A, a bandwidth (1.5 Mbps) required by a user and the IP address of an important server communicated with in dedicated fashion by the user have been registered in association with a user identifier.

5 I. When the user having the user identifier "fujitsu" logs in to the communication terminal (client) 11 having the IP address 192.169.10.20 (= IPc), the client 11 sends the directory server 16 an LDAP message for updating the information concerning the user 10 identifier "fujitsu". The LDAP message contains the user identifier "fujitsu" and the IP address of the client. The directory server 16 registers the IP address of the client in association with the user identifier "fujitsu" in the database (see Fig. 19B).

15 II. The event notifier 17 within the directory server 16 detects log-in and notifies the configuration server 18 of the fact that a user having the user identifier "fujitsu" has logged in to the client 11 having the IP address IPc.

20 III. The configuration server 18 queries the directory server in regard to the required user bandwidth by LDAP using the user identifier "fujitsu" as the key and obtains, as a response, the fact that the address of the server 12 is 192.168.20.30 (= IPa) and 25 that the required bandwidth is 1.5 Mbps.

IV. Next, on the basis of OSPF information, the configuration server 18 finds a router that relays the communication between the client 11 and the server 12.

Assume that the IP address of the one router 14₁ is "192.168.15.1 (= IPr)".

V. The configuration server 18 obtains router information (state and information relating to the 5 configuration items) concerning the router 14₁. As a result, the router 14₁ can be configured using Telnet and the configuration server 18 can ascertain that this router is capable of having its bandwidth configured.

VI. The configuration server 18 performs Telnet 10 communication with respect to the router 14₁ of IP address IPr and performs configuring to allocate the bandwidth of 1.5 Mbps for communication for which the IP address on the originating side is IPc and the IP address at the destination is IPA.

15 VII. The above-described allocating of bandwidth is performed for other routers as well.

The foregoing is for a case where bandwidth is controlled. However, control of packet discard rate and control of delay can be performed in similar fashion. 20 Further, an arrangement can be adopted in which two or more types of control such as control of bandwidth, control of discard rate and control of data, inclusive of control of priority, can be performed simultaneously.

Thus, in accordance with the present invention, a 25 network device is found on a communication path connecting a communication terminal employed by a user and a server that is the destination with which this terminal communicates, and priority is controlled by

configuring priority information, which conforms to the priority of the user, for this network device. As a result, control of priority can be performed dynamically, without using a specific protocol such as 5 RSVP, even if there is a change in a terminal employed by a user or a change in network configuration due to the addition of a network device.

Further, in accordance with the present invention, communication can be performed between a terminal 10 employed by a user and a server, with which this terminal communicates, at a priority set for the user in advance. As a result, by setting a priority that takes the post of an employee and organization, etc., into account in an enterprise network, it is possible to 15 perform communication based upon priority control commensurate with the set priority.

Further, in accordance with the present invention, there is provided a database for storing, in association with a user identifier, user information that includes 20 the address of a server that is the destination of communication and the user priority. An event notification device acquires user priority and the server address from the database and reports these to a network-device controller. As a result, the user, 25 merely by entering the user identifier from a prescribed communication terminal and logging in, establishes a communication path between this communication terminal and the server with which the user wishes to

communicate. Communication between the terminal employed by the user and the server can be performed at the priority set for the user beforehand.

Further, in accordance with the present invention, 5 when an application is launched after user log-in, the priority control mentioned above is carried out. As a result, the configuring of priority control necessary for the user in a network can be performed at a time when priority control is required and with respect to a 10 device that requires control of priority.

Further, in accordance with the present invention, a network device is found on a communication path connecting a communication terminal employed by a user and a server that is the destination with which this 15 terminal communicates, and priority is controlled by configuring priority information, which conforms to the priority of an application that has been launched, for this network device. As a result, control of priority can be performed dynamically, without using a specific 20 protocol such as RSVP, even if there is a change in a terminal employed by a user or a change in network configuration due to the addition of a network device.

Further, in accordance with the present invention, communication can be performed between a terminal 25 employed by a user and a server, with which this terminal communicates, at a priority set for an application in advance. As a result, by configuring priorities for various applications in an enterprise

network upon taking into account the urgency and importance of these applications, it is possible to perform communication based upon control of priority commensurate with the set priority.

5 Further, in accordance with the present invention, an event notification device acquires the priority of an application, the address of a server that is the destination of communication and the address of the communicating terminal from a database based upon the
10 application identifier and reports these to a network-device controller. As a result, the user, merely by entering a user identifier from a prescribed communication terminal, logging in and launching a prescribed application, establishes a communication path
15 between this communication terminal and the server that conforms to the application. Communication between the terminal employed by the user and the server can be performed at the priority set for the application beforehand.

20 Further, in accordance with the present invention, control of quality (bandwidth control, discard-rate control and delay control) can be performed dynamically without using a specific protocol even if there is a change in a terminal employed by a user or a change in
25 network configuration due to the addition of a network device. In addition, communication can be performed between a terminal employed by a user and a server, which is the destination of communication, at a quality

set for the user or application in advance.

As many apparently widely different embodiments of the present invention can be made without departing from the spirit and scope thereof, it is to be understood

5 that the invention is not limited to the specific
embodiments thereof except as defined in the appended
claims.

WHAT IS CLAIMED IS:

1. A network-device control system for performing priority control of a network device constituting a network based upon priority of an user, said system comprising:
 - 5 an event notification device for detecting that a user has logged in to a communication terminal or that a user has launched a predetermined application from a communication terminal, and reporting an identifier of the user and the fact that an event has occurred; and
 - 10 a network-device controller for performing priority control of a network device based upon information reported by said event notification device; wherein said network-device controller acquires priority of
 - 15 the user indicated by the user identifier reported by said event notification device, obtains a network device on a communication path between said communication terminal and an apparatus that is the destination of communication, generates information necessary to
 - 20 perform priority control in accordance with the user priority, and sets this priority control information in each network device.
2. The system according to claim 1, further comprising a database unit for storing, in association with a user identifier, user information that includes the address of the apparatus that is the destination of communication and the user priority; wherein said event notification device acquires the

priority of the user and the address of the apparatus that is the destination of communication from said database unit and reports these to said network-device controller.

5 3. The system according to claim 2, wherein
 when a user has logged in by inputting the user identifier, the communication terminal sends this user identifier and the address of the communication terminal to said database unit;

10 said database unit stores the address of the communication terminal in association with the user identifier; and

 said event notification device detects log-in by a change in user information in said database unit,
15 acquires the priority of the user, the address of the apparatus that is the destination of communication and the address of the communication terminal from said database unit, and reports these to said network-device controller.

20 4. The system according to claim 2, wherein
 when a user has launched a predetermined application, the communication terminal sends the user identifier, the address of the communication terminal and an application identifier of the application to said
25 database unit;

 said database unit stores the address of the communication terminal, the application identifier and the address of an apparatus that is the destination of

communication of the application in association with the user identifier; and

5 said event notification device detects an application-launch event by a change in application information in said database unit, acquires the priority of the user, the address of the apparatus that is the destination of communication and the address of the communication terminal from said database unit, and reports these to said network-device controller.

10 5. The system according to claim 1, wherein said event notification device includes:

15 an event detector for detecting that a user has logged in to a communication terminal or that a user has launched an application from a communication terminal; and

an event notifier for notifying said network-device controller of the fact that the event occurred and of the user identifier; and

said network-device controller includes:

20 an event receiver for receiving notification from said event notifier;

a priority acquisition unit for acquiring the priority of the user indicated by the received user identifier;

25 a device selector for selecting a network device which is subjected to priority control based upon the priority of the user;

a device-specific information acquisition unit for

acquiring state of configuration of the selected network device and a method of configuring the device;

5 a configuration information generator for generating priority-control configuration information for performing priority control of each network device based upon the acquired device-specific information and user priority; and

10 configuration information transmitter for transmitting the priority-control configuration information, which has been generated by said configuration information generator, to the selected network device to thereby set this information in this network device.

6. The system according to claim 2, wherein a directory 15 server is provided, said directory server being provided with said event notification device and said database unit.

7. A network-device control apparatus for performing priority control of a network device constituting a 20 network based upon priority of an user, said apparatus comprising:

an event receiver for receiving an identifier of a user from an event notifier when the user has logged in to a communication terminal or when the user has 25 launched an application;

means for acquiring priority of the user, which is indicated by the reported user identifier, and the address of an apparatus that is the destination of

20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300 305 310 315 320 325 330 335 340 345 350 355 360 365 370 375 380 385 390 395 400 405 410 415 420 425 430 435 440 445 450 455 460 465 470 475 480 485 490 495 500 505 510 515 520 525 530 535 540 545 550 555 560 565 570 575 580 585 590 595 600 605 610 615 620 625 630 635 640 645 650 655 660 665 670 675 680 685 690 695 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780 785 790 795 800 805 810 815 820 825 830 835 840 845 850 855 860 865 870 875 880 885 890 895 900 905 910 915 920 925 930 935 940 945 950 955 960 965 970 975 980 985 990 995 1000

communication by said communication terminal;

a device selector for selecting network devices on a path along which the communication terminal and the apparatus that is the destination of communication

5 communicate;

a generating unit for generating information necessary to perform priority control in accordance with the user priority; and

means for configuring the network device with the 10 information that has been generated by said generating unit.

8. A network-device control system for performing priority control of a network device constituting a network based upon priority of an application, said 15 system comprising:

an event notification device for detecting that a user has launched a predetermined application from a communication terminal, and reporting an identifier of the application and the fact that an application-launch 20 event has occurred; and

a network-device controller for performing priority control of a network device based upon information reported by said event notification device; wherein said network-device controller acquires priority of 25 the application indicated by the application identifier reported by said event notification device, obtains network devices on a communication path between said communication terminal and an apparatus that is the

destination of communication, generates information necessary to control the network devices in accordance with the application priority, and configures each network device with this priority control information.

5 9. The system according to claim 8, further comprising a database unit for storing user information in association with a user identifier, and application information, which includes the application priority, in association with an application identifier; wherein

10 said event notification device acquires the priority of the application from said database unit and reports this application priority to said network-device controller.

15 10. The system according to claim 9, wherein when the user has launched a predetermined application, the communication terminal sends the application identifier and the address of the apparatus that is the destination of communication to said database unit and said database unit stores the application identifier and the address of the apparatus, which is the destination of communication, in association with the user identifier; and

20 said event notification device detects occurrence of an application-launch event by a change in the application information in the user information in said database unit, acquires the priority of the application, the address of the apparatus that is the destination of communication and the address of the communication

20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300 305 310 315 320 325 330 335 340 345 350 355 360 365 370 375 380 385 390 395 400 405 410 415 420 425 430 435 440 445 450 455 460 465 470 475 480 485 490 495 500 505 510 515 520 525 530 535 540 545 550 555 560 565 570 575 580 585 590 595 600 605 610 615 620 625 630 635 640 645 650 655 660 665 670 675 680 685 690 695 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780 785 790 795 800 805 810 815 820 825 830 835 840 845 850 855 860 865 870 875 880 885 890 895 900 905 910 915 920 925 930 935 940 945 950 955 960 965 970 975 980 985 990 995 1000 1005 1010 1015 1020 1025 1030 1035 1040 1045 1050 1055 1060 1065 1070 1075 1080 1085 1090 1095 1100 1105 1110 1115 1120 1125 1130 1135 1140 1145 1150 1155 1160 1165 1170 1175 1180 1185 1190 1195 1200 1205 1210 1215 1220 1225 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4230 4235 4240 4245 4250 4255 4260 4265 4270 4275 4280 4285 4290 4295 4300 4305 4310 4315 4320 4325 4330 4335 4340 4345 4350 4355 4360 4365 4370 4375 4380 4385 4390 4395 4400 4405 4410 4415 4420 4425 4430 4435 4440 4445 4450 4455 4460 4465 4470 4475 4480 4485 4490 4495 4500 4505 4510 4515 4520 4525 4530 4535 4540 4545 4550 4555 4560 4565 4570 4575 4580 4585 4590 4595 4600 4605 4610 4615 4620 4625 4630 4635 4640 4645 4650 4655 4660 4665 4670 4675 4680 4685 4690 4695 4700 4705 4710 4715 4720 4725 4730 4735 4740 4745 4750 4755 4760 4765 4770 4775 4780 4785 4790 4795 4800 4805 4810 4815 4820 4825 4830 4835 4840 4845 4850 4855 4860 4865 4870 4875 4880 4885 4890 4895 4900 4905 4910 4915 4920 4925 4930 4935 4940 4945 4950 4955 4960 4965 4970 4975 4980 4985 4990 4995 5000 5005 5010 5015 5020 5025 5030 5035 5040 5045 5050 5055 5060 5065 5070 5075 5080 5085 5090 5095 5100 5105 5110 5115 5120 5125 5130 5135 5140 5145 5150 5155 5160 5165 5170 5175 5180 5185 5190 5195 5200 5205 5210 5215 5220 5225 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7230 7235 7240 7245 7250 7255 7260 7265 7270 7275 7280 7285 7290 7295 7300 7305 7310 7315 7320 7325 7330 7335 7340 7345 7350 7355 7360 7365 7370 7375 7380 7385 7390 7395 7400 7405 7410 7415 7420 7425 7430 7435 7440 7445 7450 7455 7460 7465 7470 7475 7480 7485 7490 7495 7500 7505 7510 7515 7520 7525 7530 7535 7540 7545 7550 7555 7560 7565 7570 7575 7580 7585 7590 7595 7600 7605 7610 7615 7620 7625 7630 7635 7640 7645 7650 7655 7660 7665 7670 7675 7680 7685 7690 7695 7700 7705 7710 7715 7720 7725 7730 7735 7740 7745 7750 7755 7760 7765 7770 7775 7780 7785 7790 7795 7800 7805 7810 7815 7820 7825 7830 7835 7840 7845 7850 7855 7860 7865 7870 7875 7880 7885 7890 7895 7900 7905 7910 7915 7920 7925 7930 7935 7940 7945 7950 7955 7960 7965 7970 7975 7980 7985 7990 7995 8000 8005 8010 8015 8020 8025 8030 8035 8040 8045 8050 8055 8060 8065 8070 8075 8080 8085 8090 8095 8100 8105 8110 8115 8120 8125 8130 8135 8140 8145 8150 8155 8160 8165 8170 8175 8180 8185 8190 8195 8200 8205 8210 8215 8220 8225 8230 8235 8240 8245 8250 8255 8260 8265 8270 8275 8280 8285 8290 8295 8300 8305 8310 8315 8320 8325 8330 8335 8340 8345 8350 8355 8360 8365 8370 8375 8380 8385 8390 8395 8400 8405 8410 8415 8420 8425 8430 8435 8440 8445 8450 8455 8460 8465 8470 8475 8480 8485 8490 8495 8500 8505 8510 8515 8520 8525 8530 8535 8540 8545 8550 8555 8560 8565 8570 8575 8580 8585 8590 8595 8600 8605 8610 8615 8620 8625 8630 8635 8640 8645 8650 8655 8660 8665 8670 8675 8680 8685 8690 8695 8700 8705 8710 8715 8720 8725 8730 8735 8740 8745 8750 8755 8760 8765 8770 8775 8780 8785 8790 8795 8800 8805 8810 8815 8820 8825 8830 8835 8840 8845 8850 8855 8860 8865 8870 8875 8880 8885 8890 8895 8900 8905 8910 8915 8920 8925 8930 8935 8940 8945 8950 8955 8960 8965 8970 8975 8980 8985 8990 8995 9000 9005 9010 9015 9020 9025 9030 9035 9040 9045 9050 9055 9060 9065 9070 9075 9080 9085 9090 9095 9100 9105 9110 9115 9120 9125 9130 9135 9140 9145 9150 9155 9160 9165 9170 9175 9180 9185 9190 9195 9200 9205 9210 9215 9220 9225 9230 9235 9240 9245 9250 9255 9260 9265 9270 9275 9280 9285 9290 9295 9300 9305 9310 9315 9320 9325 9330 9335 9340 9345 9350 9355 9360 9365 9370 9375 9380 9385 9390 9395 9400 9405 9410 9415 9420 9425 9430 9435 9440 9445 9450 9455 9460 9465 9470 9475 9480 9485 9490 9495 9500 9505 9510 9515 9520 9525 9530 9535 9540 9545 9550 9555 9560 9565 9570 9575 9580 9585 9590 9595 9600 9605 9610 9615 9620 9625 9630 9635 9640 9645 9650 9655 9660 9665 9670 9675 9680 9685 9690 9695 9700 9705 9710 9715 9720 9725 9730 9735 9740 9745 9750 9755 9760 9765 9770 9775 9780 9785 9790 9795 9800 9805 9810 9815 9820 9825 9830 9835 9840 9845 9850 9855 9860 9865 9870 9875 9880 9885 9890 9895 9900 9905 9910 9915 9920 9925 9930 9935 9940 9945 9950 9955 9960 9965 9970 9975 9980 9985 9990 9995 9999

terminal from said database unit, and reports these to said network-device controller.

11. The system according to claim 8, wherein said event notification device includes:

5 an event detector for detecting that a communication terminal has given rise to an application-launch event; and

 an event notifier for notifying said network-device controller of the fact that the event occurred and of

10 the application identifier; and

 said network-device controller includes:

 an event receiver for receiving notification from said event notifier;

 a priority acquisition unit for acquiring the 15 priority of the application indicated by the received application identifier;

 a device selector for selecting a network device which is subjected to priority control based upon the priority of the application;

20 a device-specific information acquisition unit for acquiring state of configuration of the selected network device and a method of configuring the device;

 a configuration information generator for generating priority-control configuration information

25 for performing priority control of each network device based upon the acquired device-specific information and application priority; and

 configuration information transmitter for

transmitting the priority-control configuration information, which has been generated by said configuration information generator, to the selected network device to thereby set this information in this 5 network device.

12. The system according to claim 9, wherein a directory server is provided, said directory server being provided with said event notification device and said database unit.

10 13. A network-device control apparatus for performing priority control of a network device constituting a network based upon priority of an application, said apparatus comprising:

an event receiver for receiving an identifier of an 15 application from an event notification device when a user has launched an application at a communication terminal;

means for acquiring priority of the application, which is indicated by the notified application 20 identifier, and the address of an apparatus that is the destination of communication by said communication terminal based upon the application;

a device selector for selecting network devices on a path along which the communication terminal and the 25 apparatus that is the destination of communication communicate;

a generating unit for generating information necessary to perform priority control in accordance with

the application priority; and

means for configuring the network device with the information that has been generated by said generating unit.

5 14. A network-device control system for controlling any one of bandwidth, discard rate and delay of a network device constituting a network, said system comprising:

an event notification device for detecting that a user has logged in to a communication terminal or that a

10 user has launched a predetermined application from a communication terminal, and reporting an identifier of the user and the fact that an event has occurred; and

a network-device controller for controlling any one of bandwidth, discard rate and delay of a network device

15 based upon information reported by said event notification device;

said network-device controller:

acquiring any one of a bandwidth value, discard-rate value and delay value conforming to a user

20 identified by the user identifier reported by said event notification device;

obtaining network devices on a communication path between said communication terminal and an apparatus that is the destination of communication;

25 generating configuration information necessary to control any one of bandwidth, discard rate and delay in accordance with the value acquired; and

configuring each network device with this generated

configuration information.

15. A network-device control apparatus for controlling any one of bandwidth, discard rate and delay of a network device constituting a network, said apparatus comprising:

an event receiver for receiving at least an identifier of a user from an event notification device when the user has logged in to a communication terminal or when the user has launched an application;

10 means for acquiring any one of a bandwidth value, discard-rate value and delay value conforming to a user identified by the notified user identifier, and the address of an apparatus that is the destination of communication by said communication terminal;

15 a device selector for selecting a network device on a path along which the communication terminal and the apparatus that is the destination of communication communicate;

20 a generating unit for generating configuration information necessary to control any one of bandwidth, discard rate and delay in accordance with said value acquired; and

means for configuring the network device with the configuration information that has been generated by 25 said generating unit.

16. A network-device control system for controlling any one of bandwidth, discard rate and delay of a network device constituting a network, said system comprising:

an event notification device for detecting that a user has launched a predetermined application at a communication terminal, and reporting an identifier of the application and the fact that an application-launch 5 event has occurred; and

a network-device controller for controlling any one of bandwidth, discard rate and delay of a network device based upon information reported by said event notification device;

10 said network-device controller:

acquiring any one of a bandwidth value, discard-rate value and delay value of an application identified by the application identifier reported by said event notification device;

15 obtaining network devices on a communication path between said communication terminal and an apparatus that is the destination of communication;

generating configuration information necessary to control any one of bandwidth, discard rate and delay in accordance with the value acquired; and

20 configuring each network device with this generated configuration information.

17. A network-device control apparatus for controlling any one of bandwidth, discard rate and delay of a 25 network device constituting a network, said apparatus comprising:

an event receiver for receiving an identifier of an application from an event identification device when a

user has a launched an application at a communication terminal;

means for acquiring any one of a bandwidth value, discard-rate value and delay value conforming to an 5 application identified by the reported application identifier, and the address of an apparatus that is the destination of communication by said communication terminal based upon the application;

a device selector for selecting a network device on 10 a path along which the communication terminal and the apparatus that is the destination of communication communicate;

a generating unit for generating configuration information necessary to control any one of bandwidth, 15 discard rate and delay in accordance with the value acquired; and

means for configuring the network device with the configuration information that has been generated by said generating unit.

ABSTRACT OF THE DISCLOSURE

In a network-device control system for controlling a network device such as a router, which is located between a communication terminal employed by a user and

5 a server with which the terminal communicates, at a priority that has been set in advance for the user or for an application, an event notification device detects that a user has logged in to the communication terminal or that the user has launched a predetermined

10 application from the communication terminal and reports the user identifier or the application identifier to a network-device controller. The latter acquires user priority or application priority on the basis of the reported identifier and, in accordance with the

15 priority, controls the router on the communication path between the communication terminal and the server.

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FIG. 1

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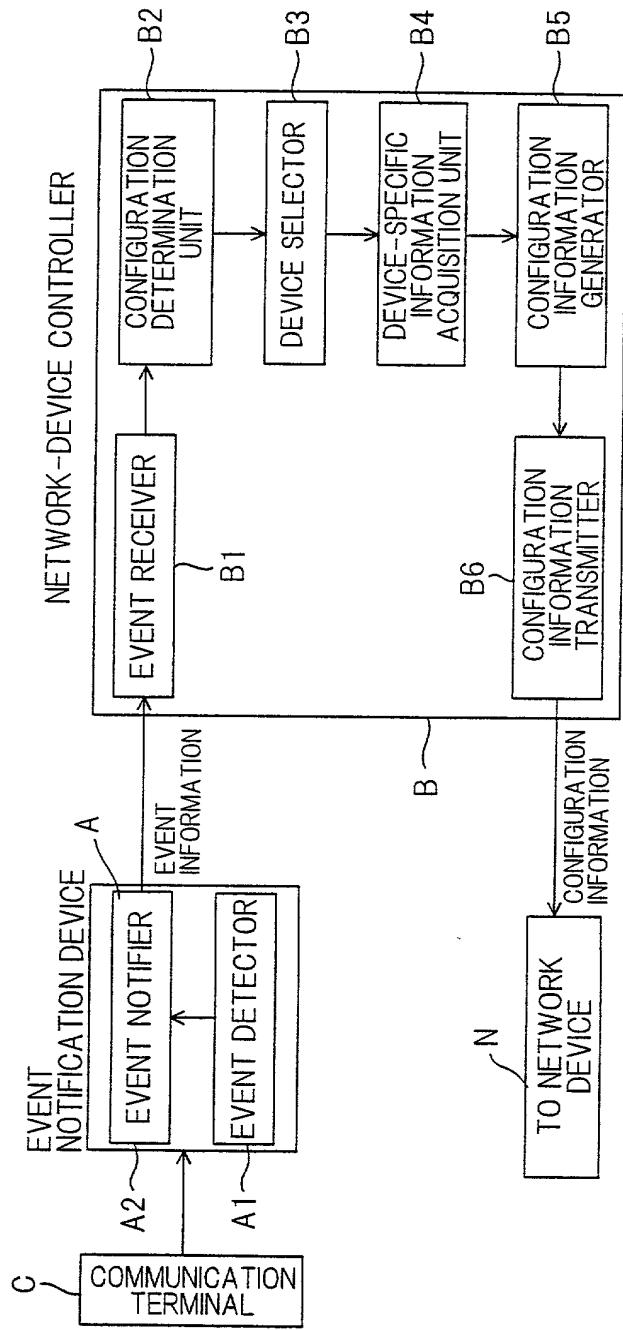


FIG.2

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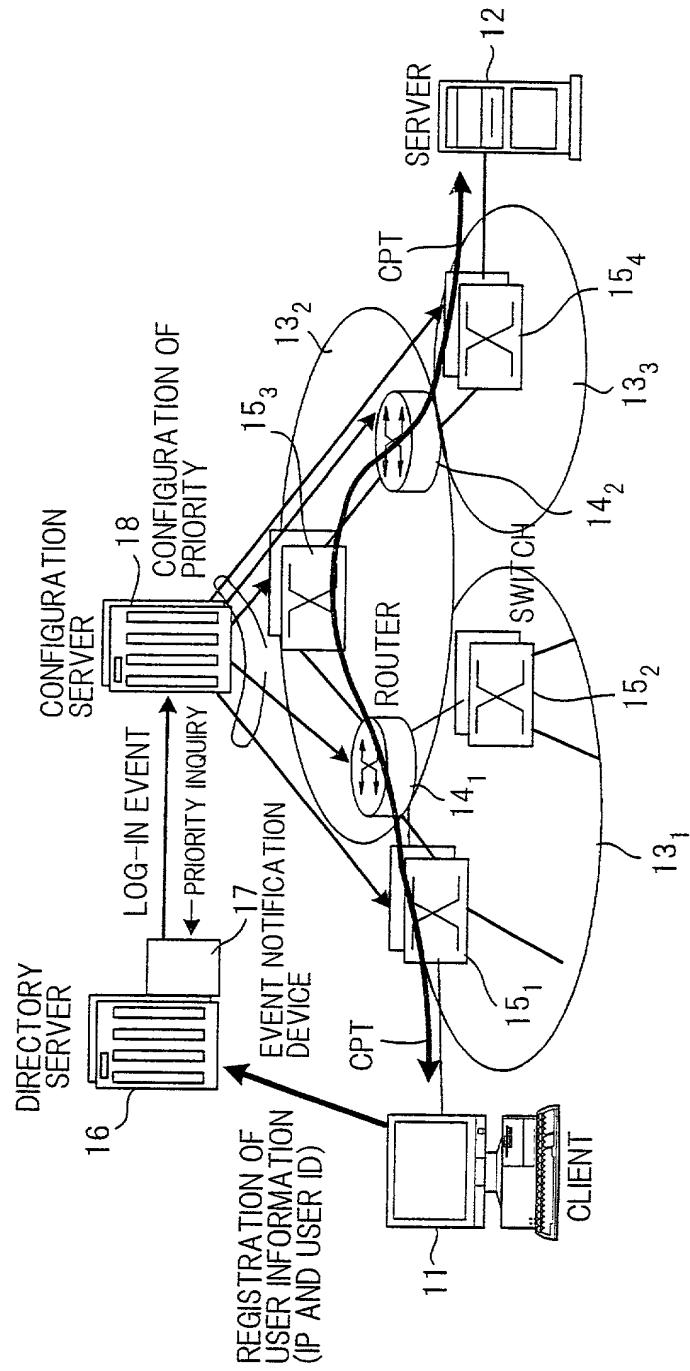


FIG.3A

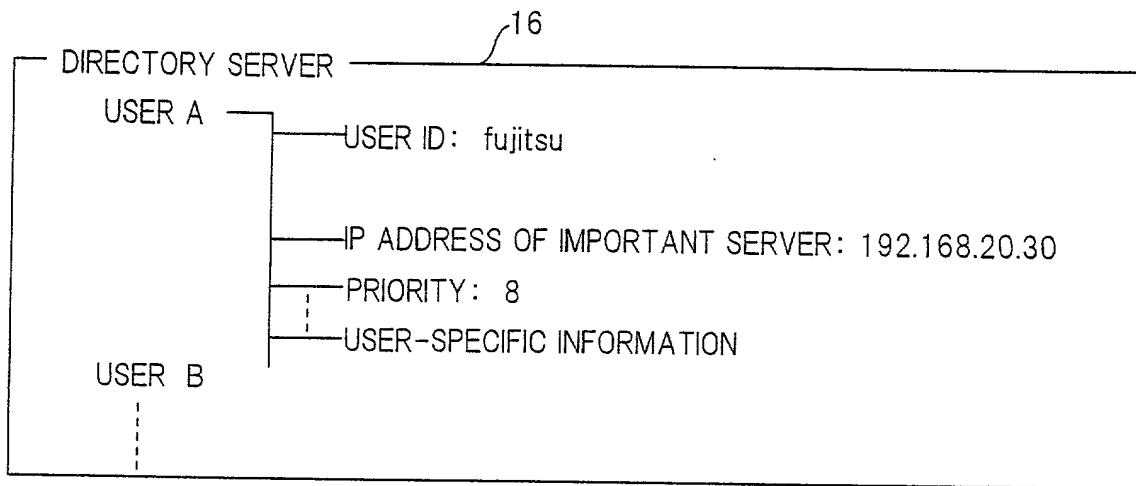


FIG.3B

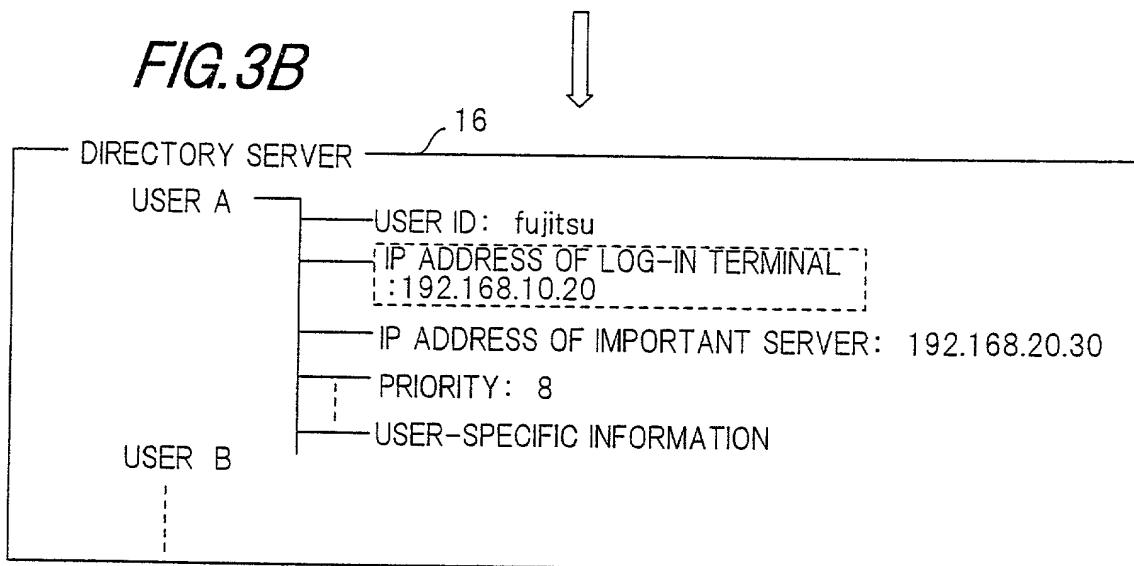


FIG.4A

| OWN NODE ADDRESS | ADJACENT NODE ADDRESS |
|-------------------|-----------------------|
| 192.168.15.1/24 A | 192.168.10.1/24 B |
| | 192.168.20.1/24 C |
| | 192.168.21.1/24 D |

FIG.4B

| OWN NODE ADDRESS | ADJACENT NODE ADDRESS |
|-------------------|-----------------------|
| 192.168.10.1/24 B | 192.168.15.1/24 A |
| | 192.168.11.1/24 E |

FIG.4C

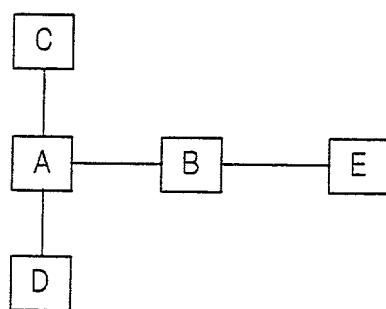


FIG.5

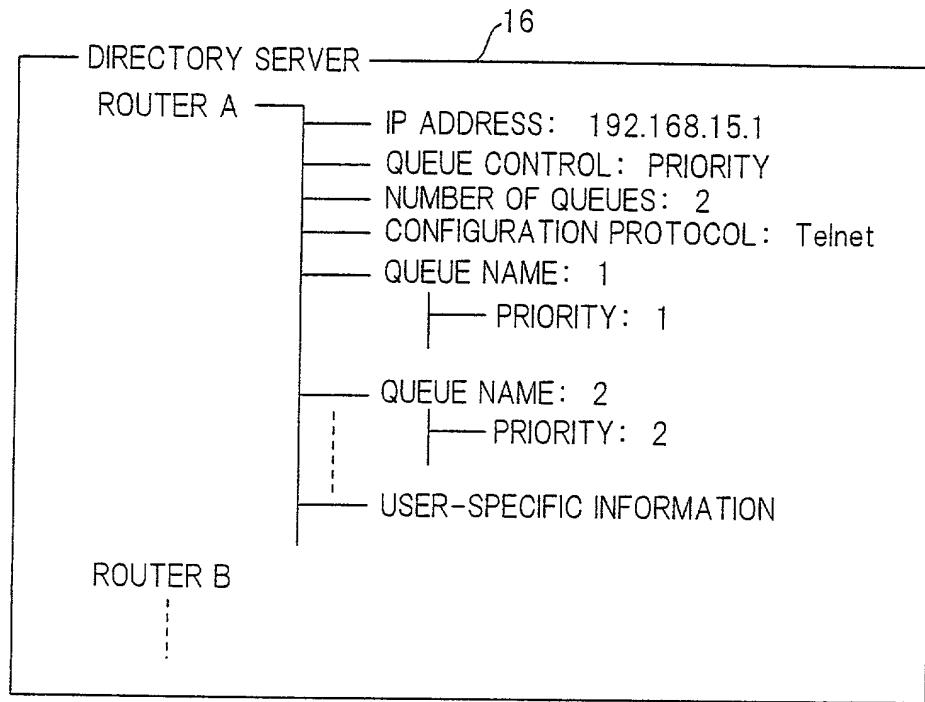


FIG.6

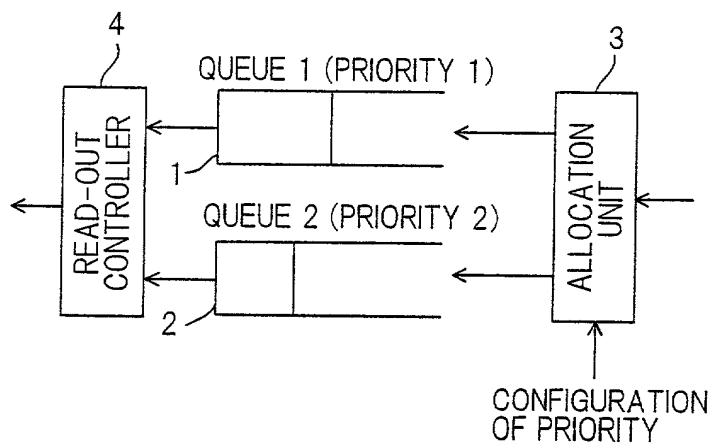


FIG.7

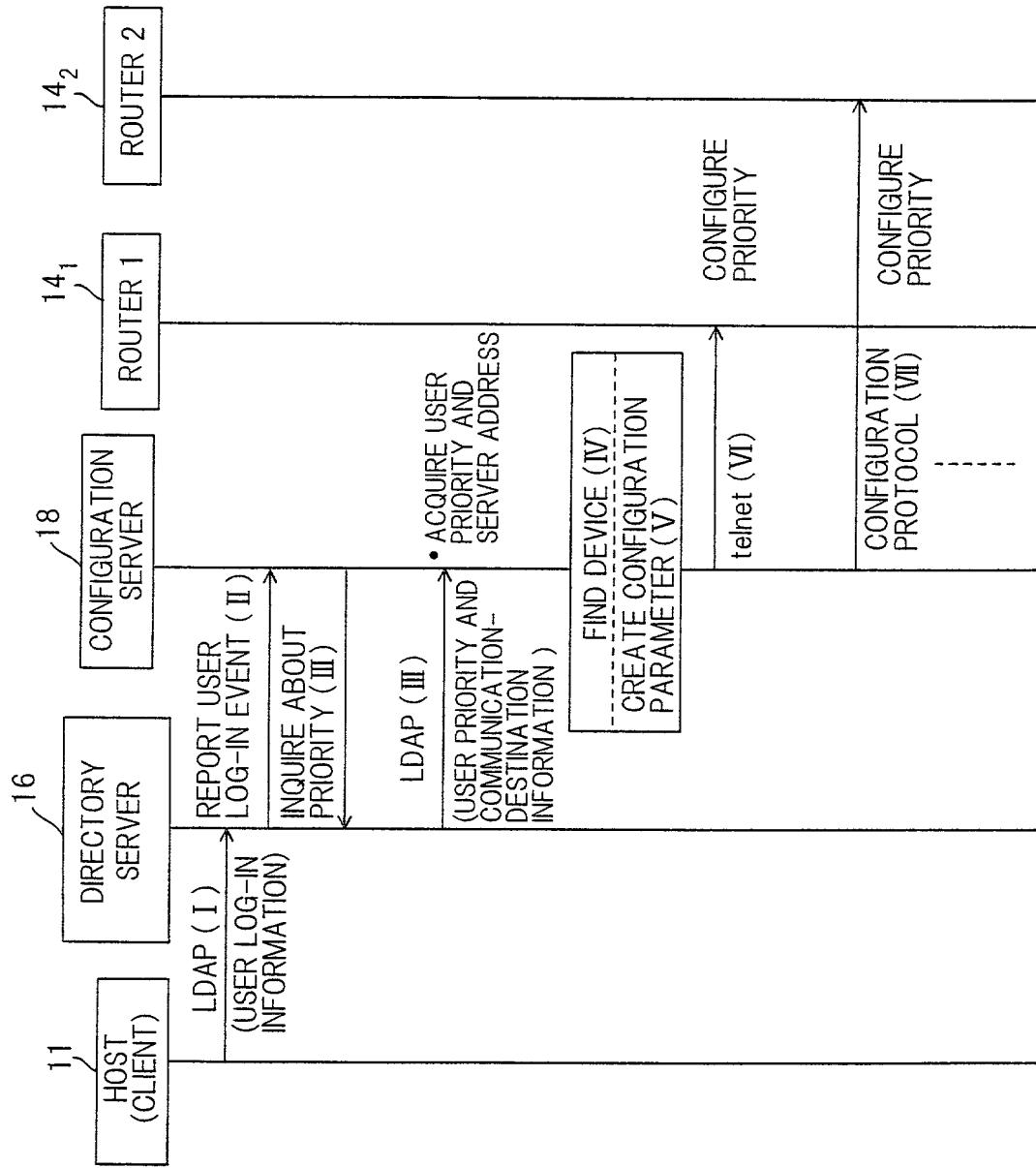


FIG. 8

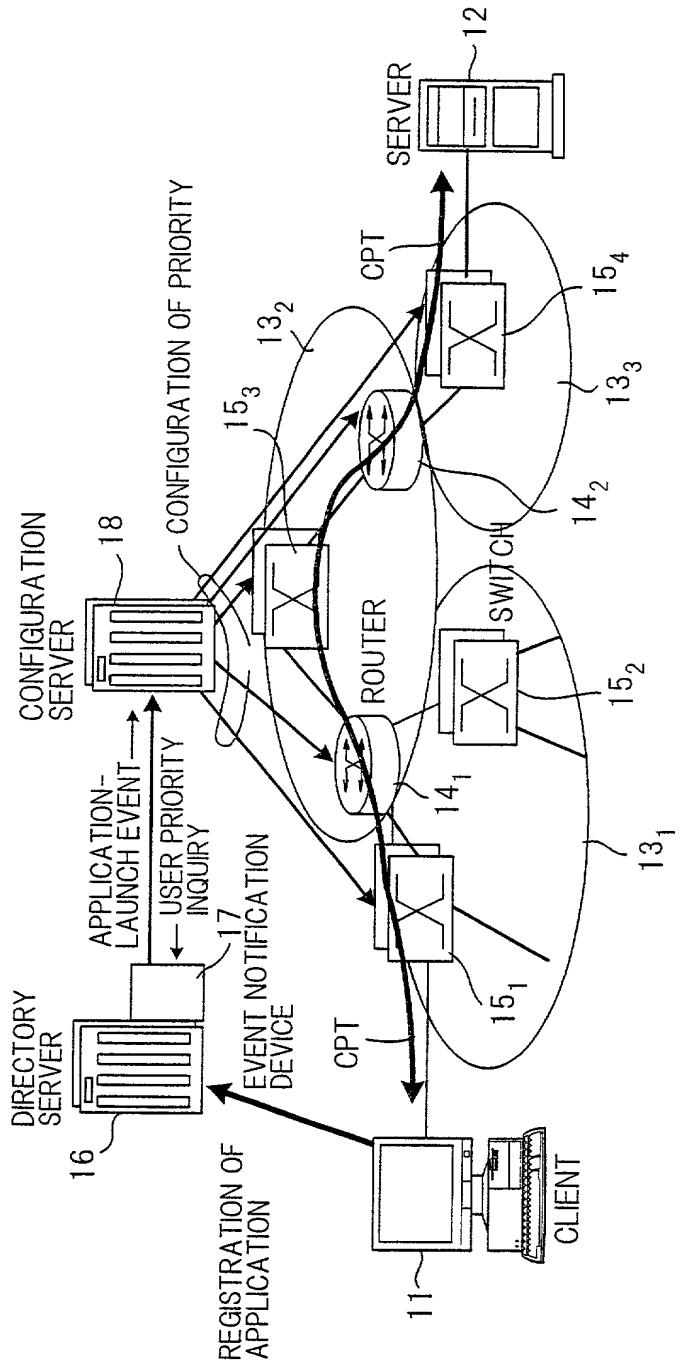


FIG.9A

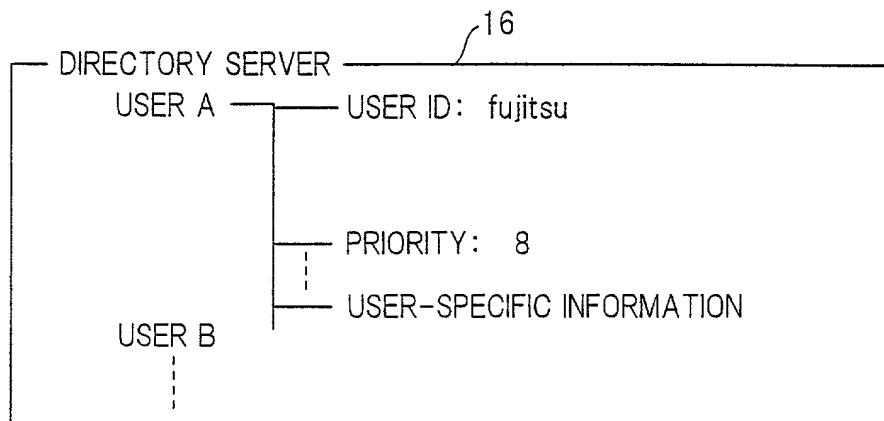


FIG.9B

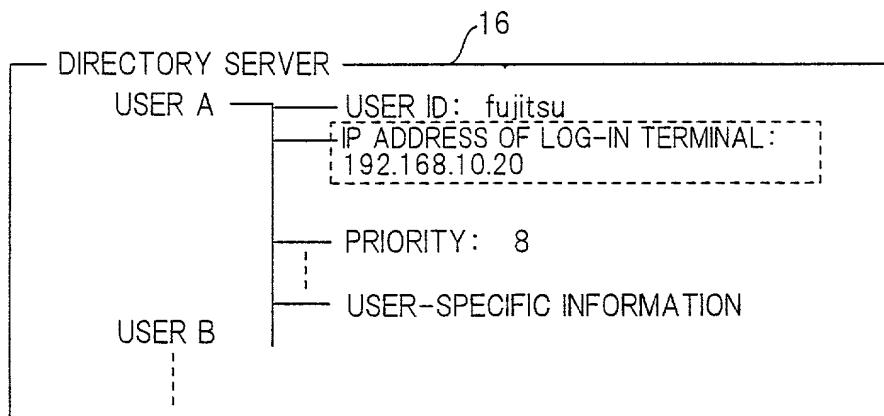


FIG.9C

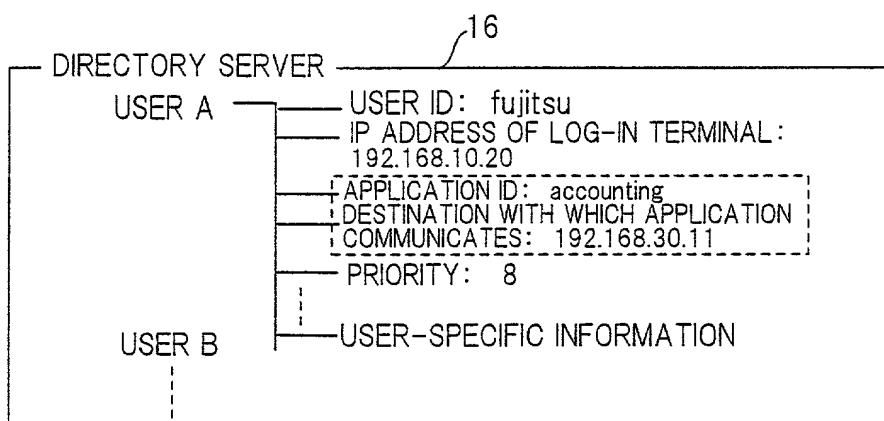


FIG. 10

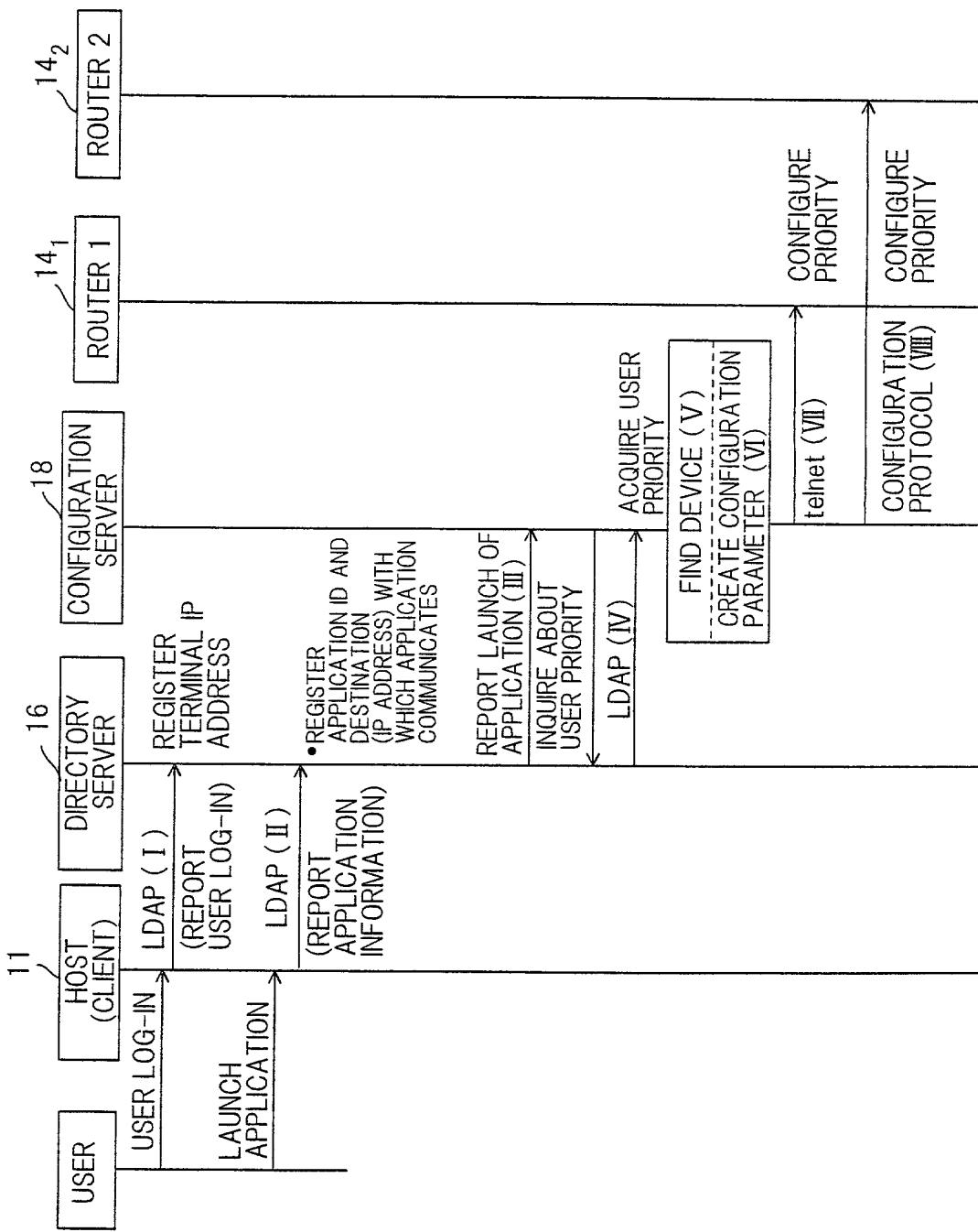
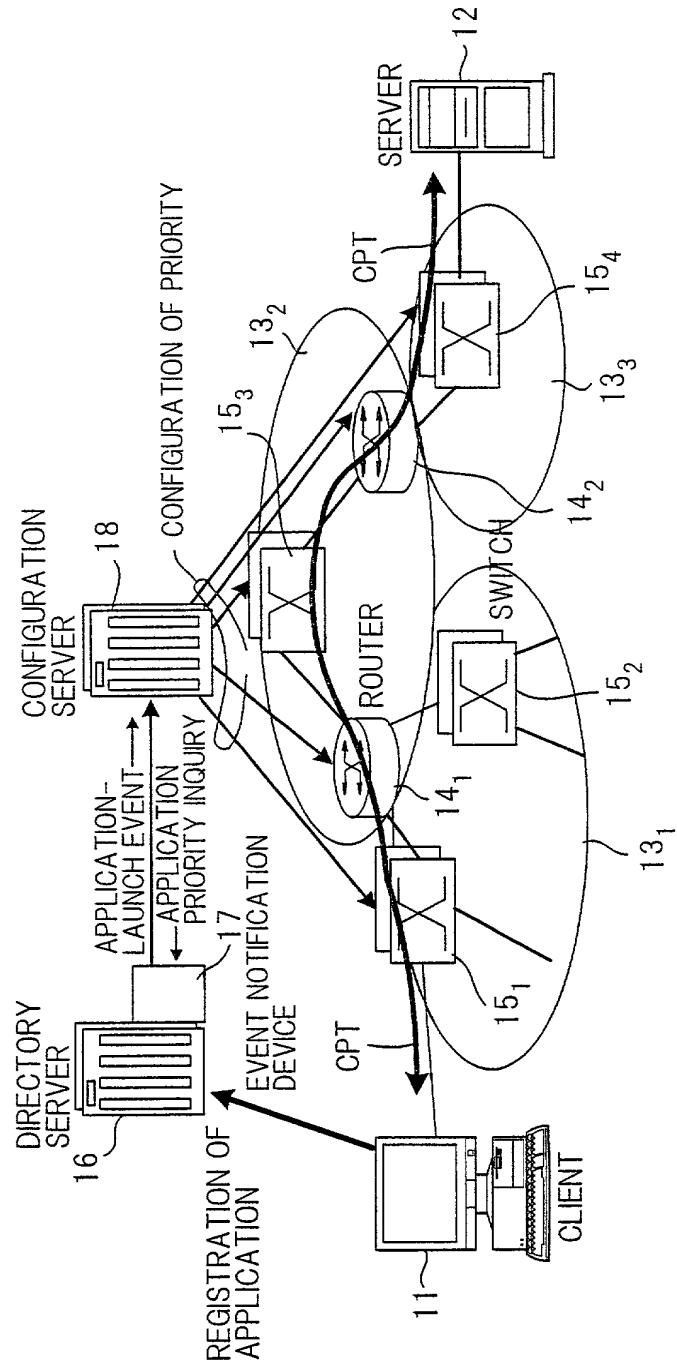


FIG. 11



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FIG. 12A

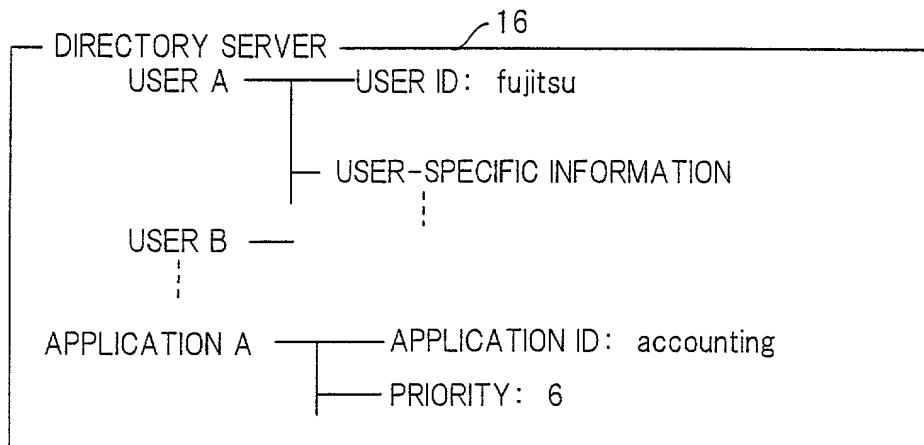


FIG. 12B

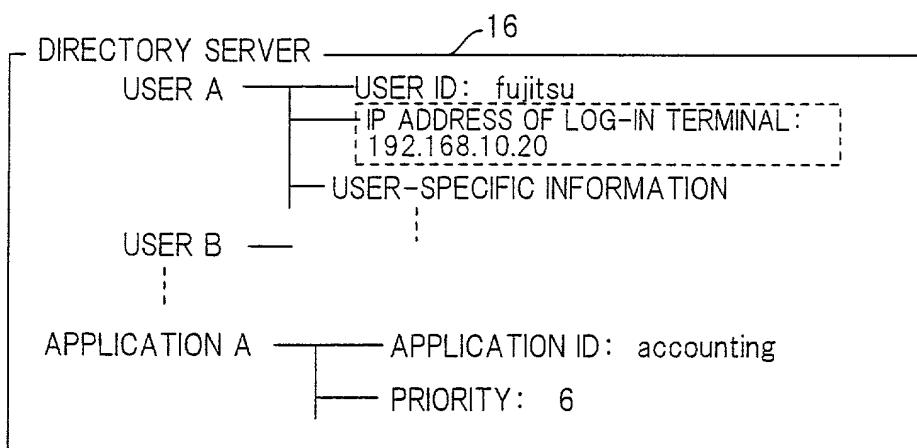


FIG. 12C

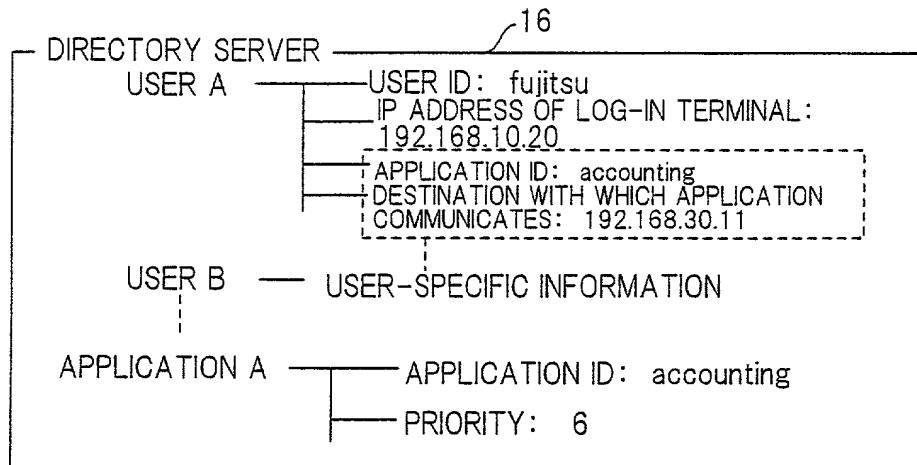


FIG. 13

11 16 18 14₂
HOST (CLIENT) DIRECTORY SERVER CONFIGURATION SERVER
USER LOG-IN → LDAP (I) → REGISTER TERMINAL IP ADDRESS

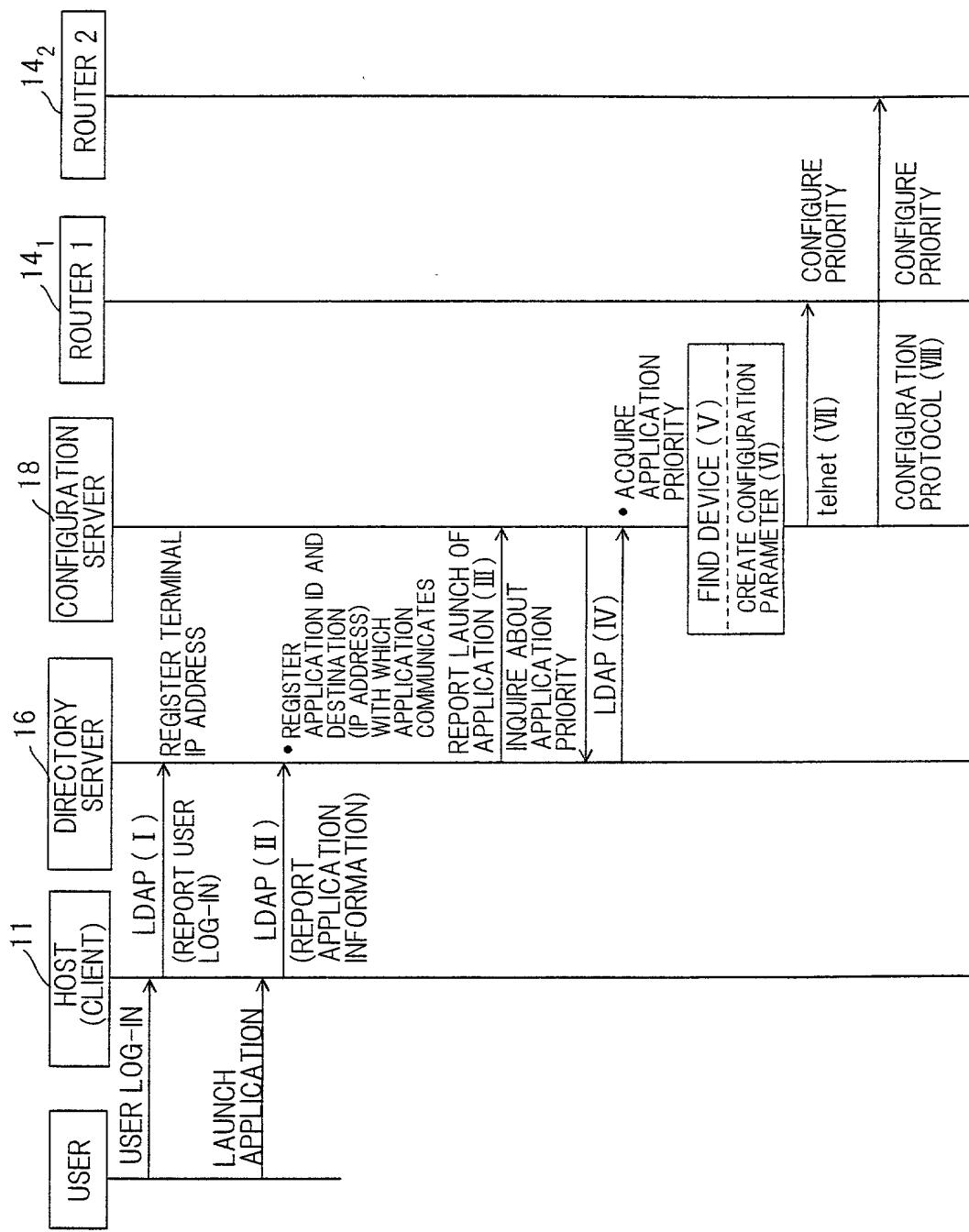


FIG. 14

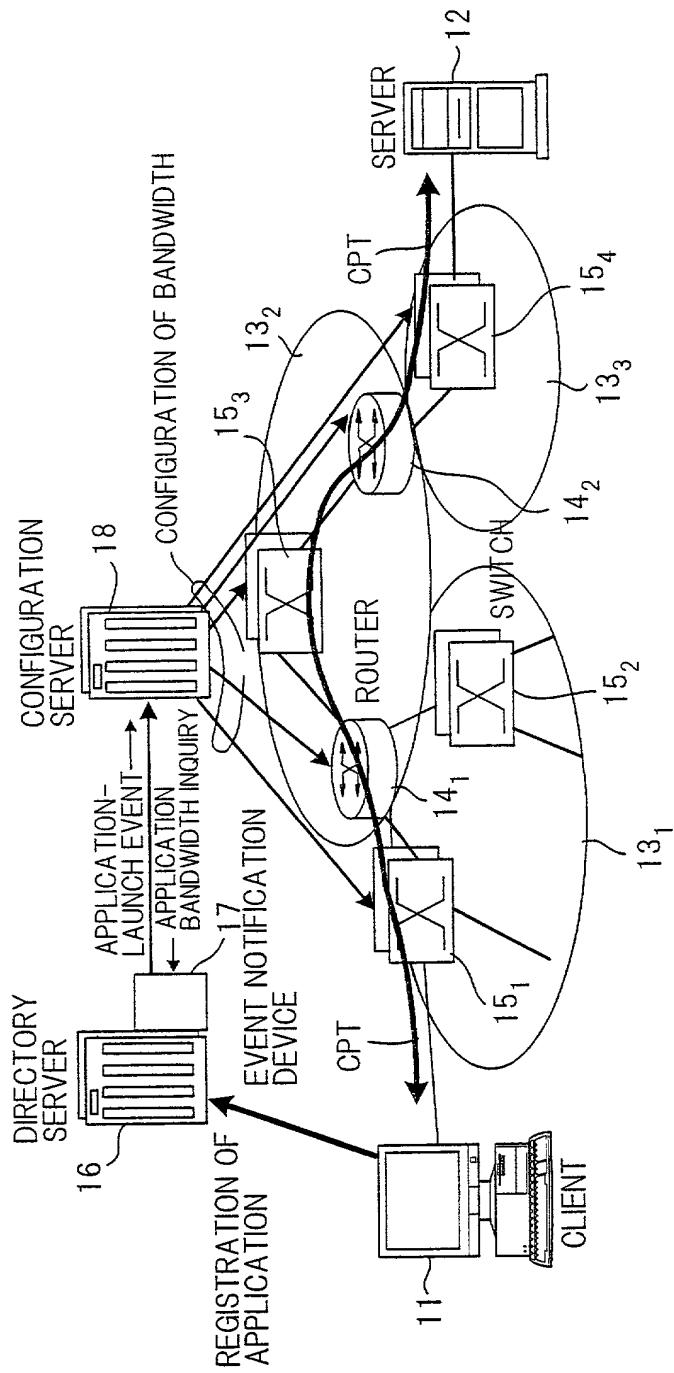


FIG. 15A

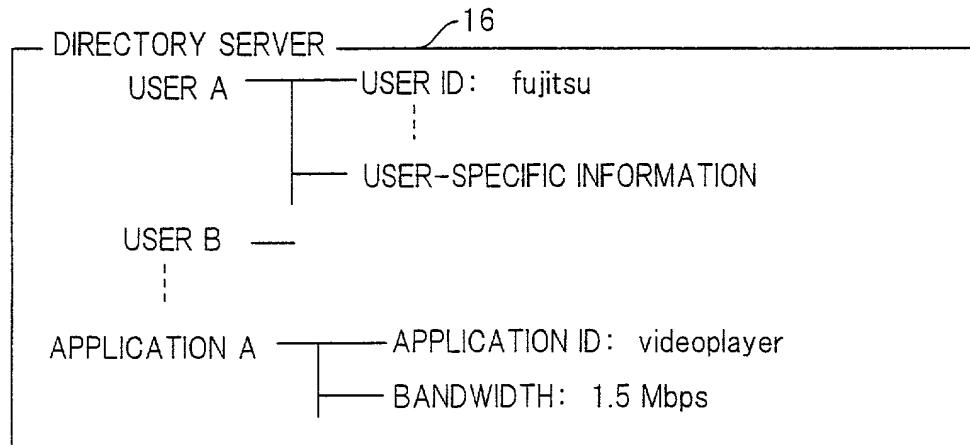


FIG. 15B

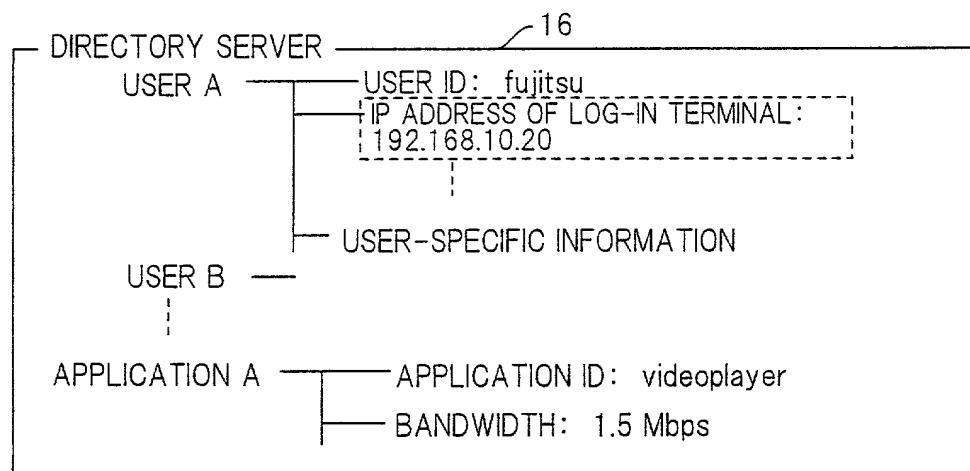


FIG. 15C

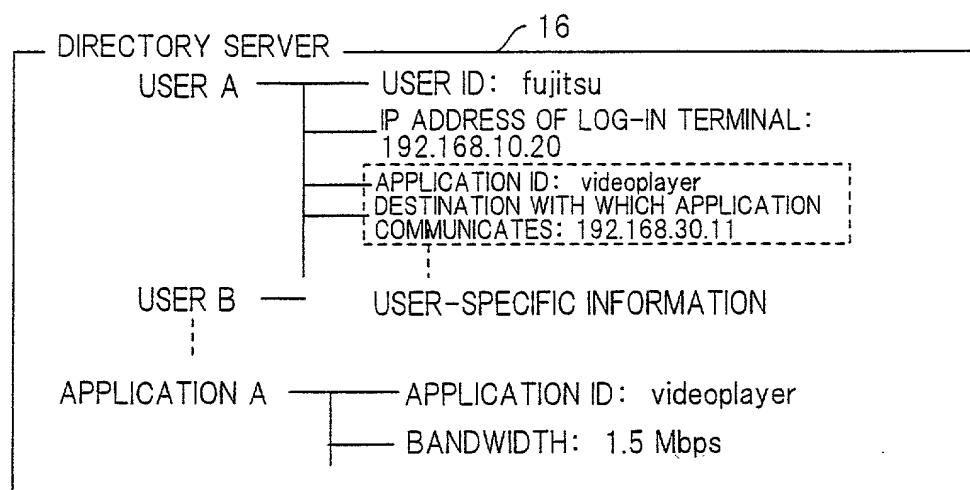


FIG. 16

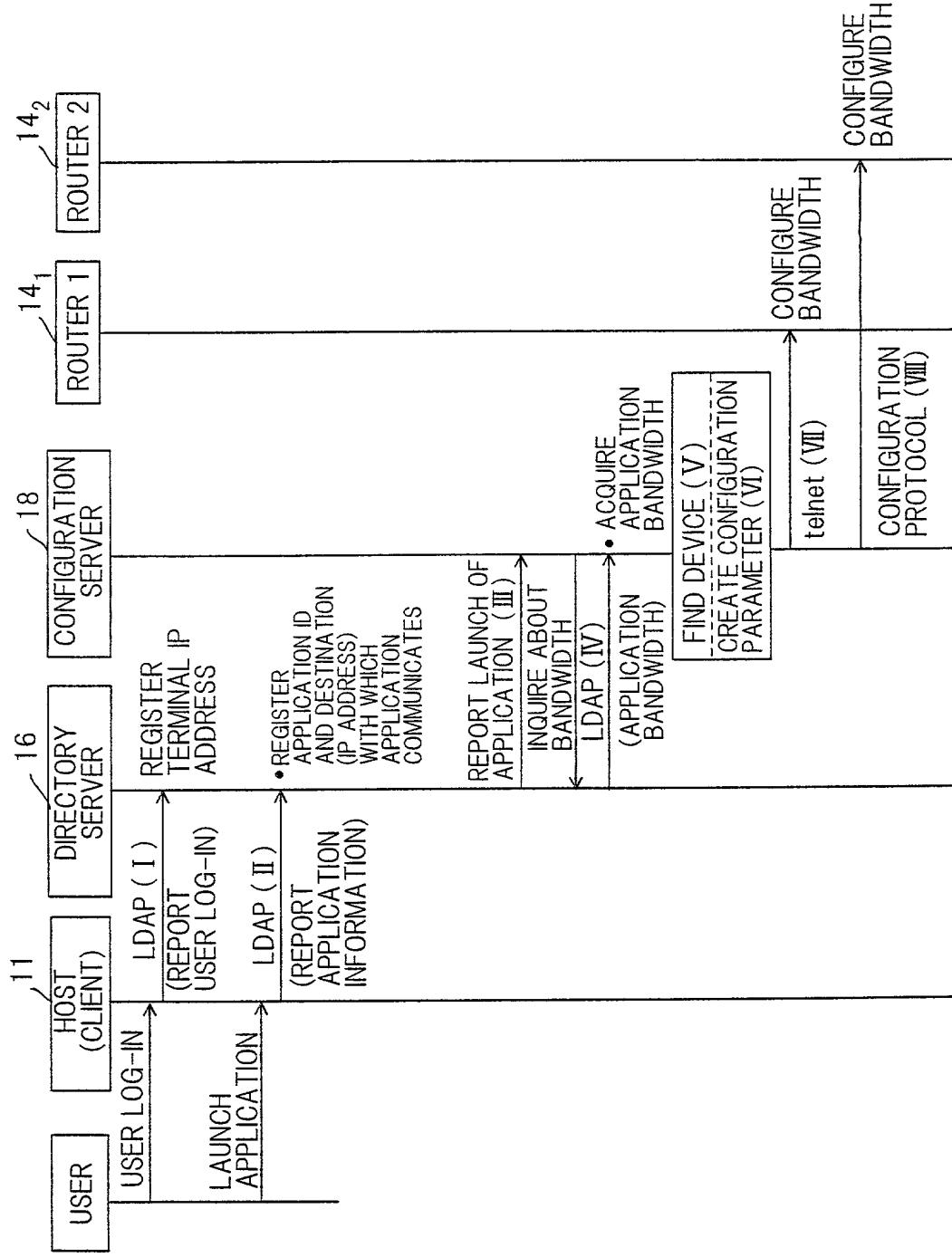


FIG. 17

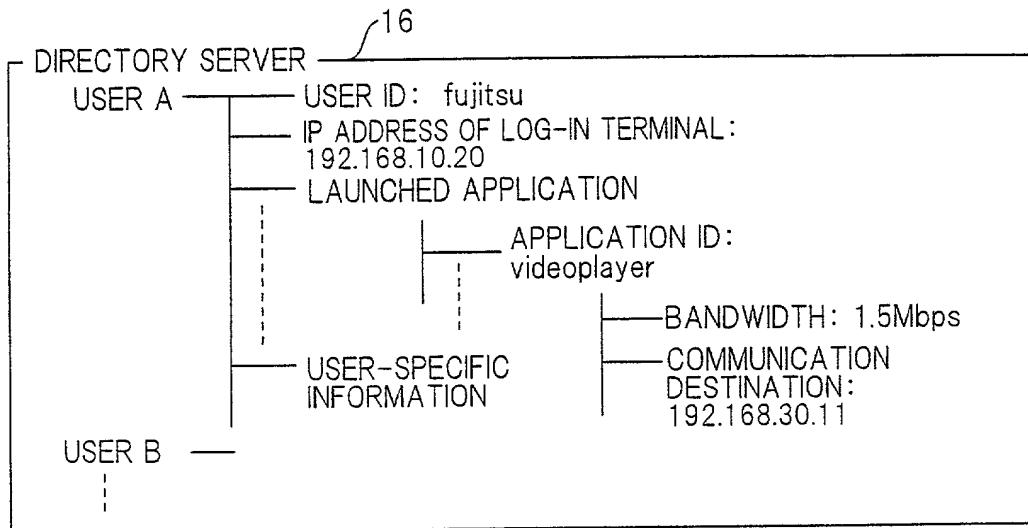


FIG. 18

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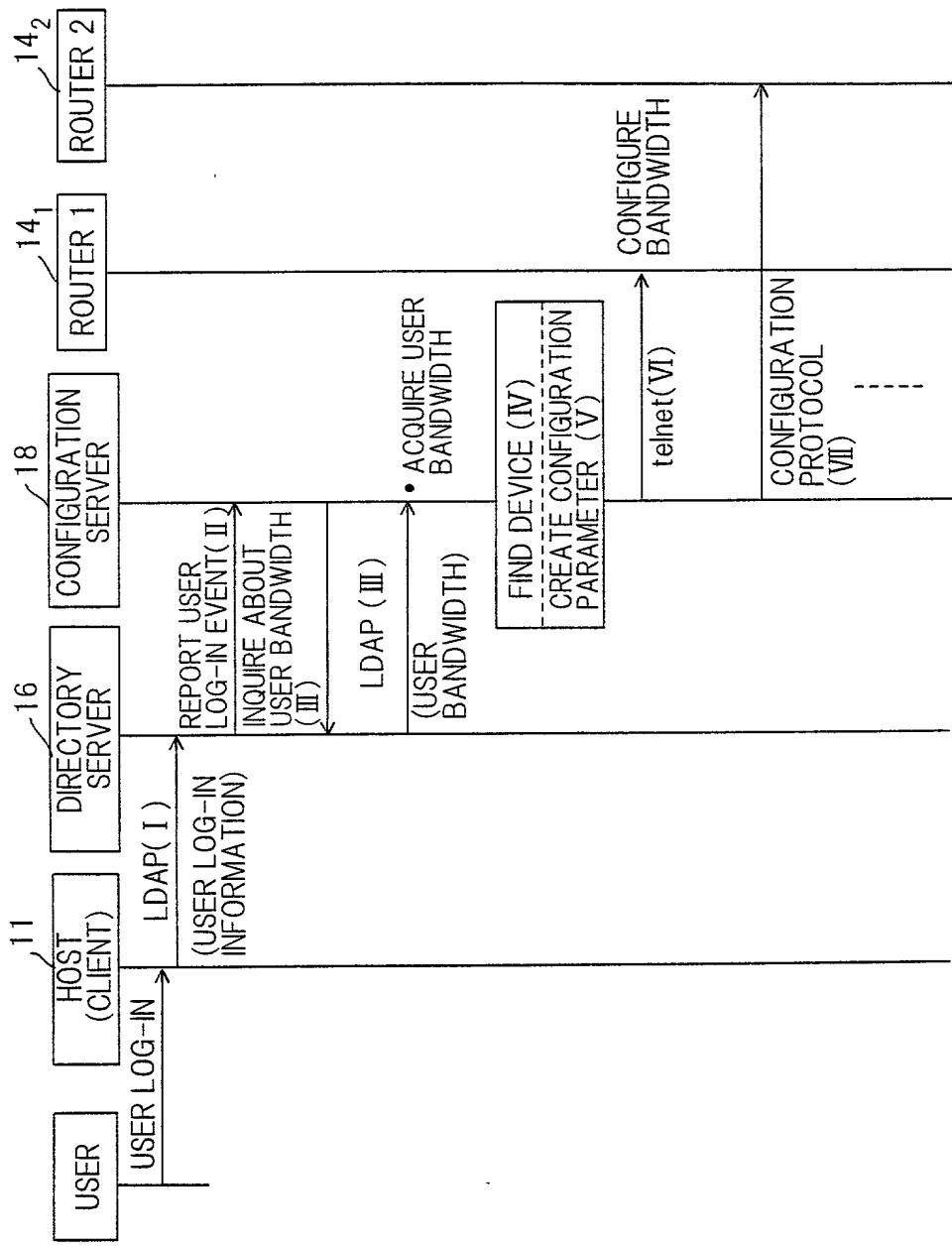


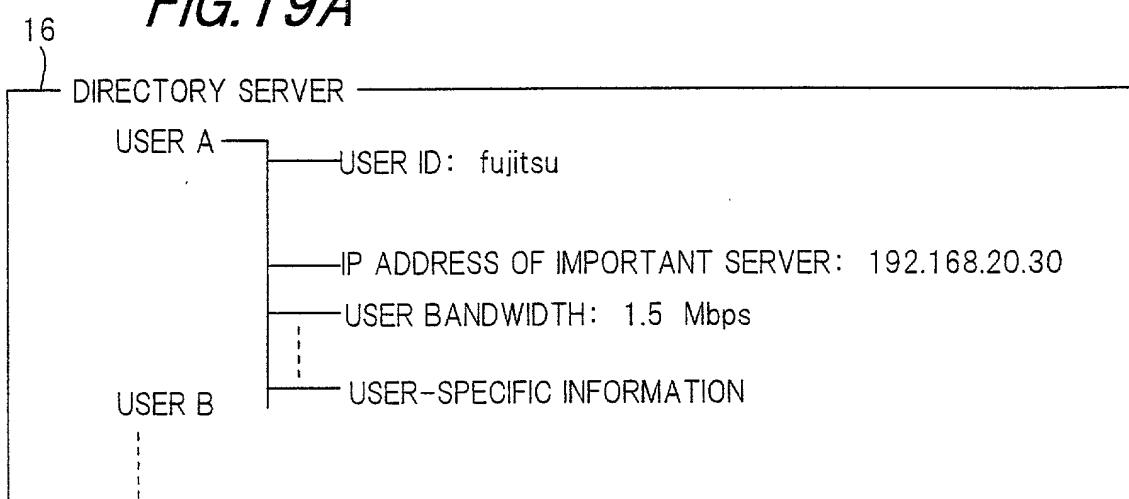
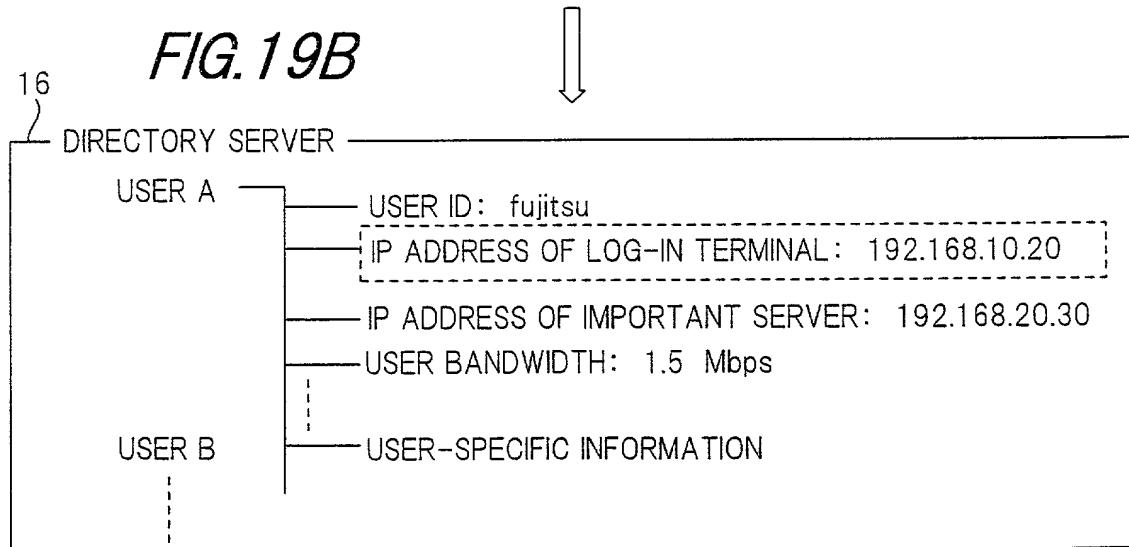
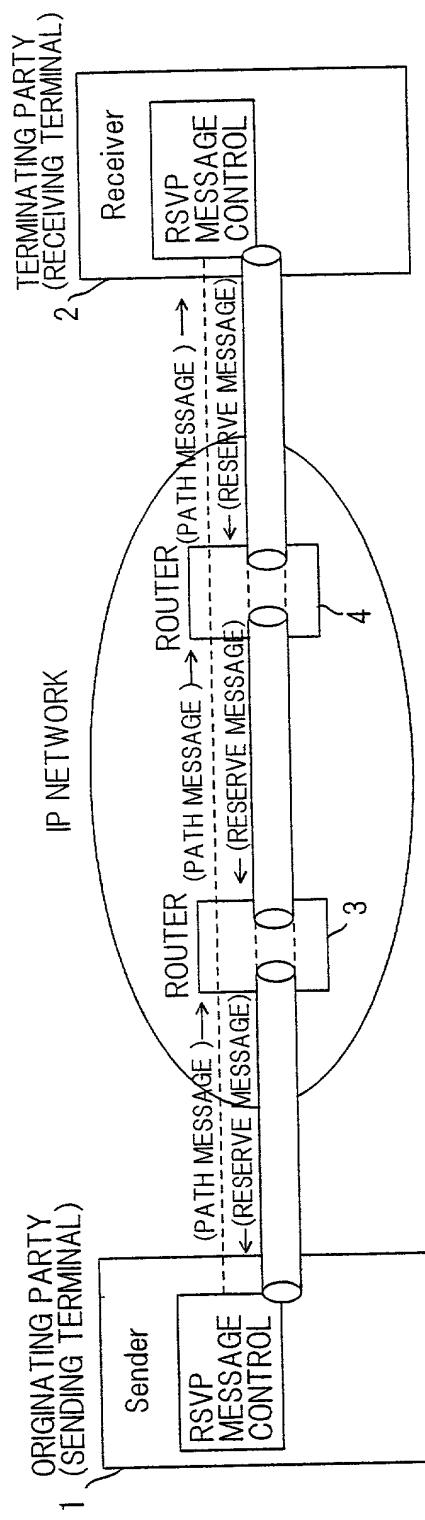
FIG. 19A*FIG. 19B*

FIG.20 PRIOR ART



Declaration and Power of Attorney For Patent Application**特許出願宣言書及び委任状****Japanese Language Declaration****日本語宣言書**

以下の氏名の発明者として、私は以下の通り宣言します。 As a below named inventor, I hereby declare that:

私の住所、私郵便、国籍は下記の私の氏名の後に記載された通りです。

My residence, post office address and citizenship are as stated next to my name.

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者であると（下記の名称が複数の場合）信じています。

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

NETWORK-DEVICE CONTROL SYSTEM**AND APPARATUS**

上記発明の明細書（下記の欄で×印がついていない場合は、本書に添付）は、

the specification of which is attached hereto unless the following box is checked:

一月一日に提出され、米国出願番号または特許協定条約国際出願番号を _____ とし、
(該当する場合) _____ に訂正されました。

was filed on _____
as United States Application Number or
PCT International Application Number
_____ and was amended on
_____ (if applicable).

私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第37編第1条56項に定義されるとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。

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私は、米国法典第35編119条(a)-(d)項又は365条(b)項に基き下記の、米国以外の国の少なくとも一ヵ国を指定している特許協力条約365(a)項に基く国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示しています。

Prior Foreign Application(s)

外国での先行出願

| | |
|----------------------|-------------------|
| TOKUGANHEI 11-007129 | Japan |
| (Number) (番号) | (Country) (国名) |
| (Number) (番号) | (Country) (国名) |

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|-----------------------------|------------------------|
| (Application No.) (出願番号) | (Filing Date) (出願日) |
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| | |
|-----------------------------|------------------------|
| (Application No.) (出願番号) | (Filing Date) (出願日) |
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|-----------------------------|------------------------|
| (Application No.) (出願番号) | (Filing Date) (出願日) |
|-----------------------------|------------------------|

私は、私自身の知識に基づいて本宣言書中で私が行なう表明が真実であり、かつ私の入手した情報と私の信じるところに基づく表明が全て真実であると信じていること、さらに故意になされた虚偽の表明及びそれと同等の行為は米国法典第18編第1001条に基づき、罰金または拘禁、もしくはその両方により処罰されること、そしてそのような故意による虚偽の声明を行なえば、出願した、又は既に許可された特許の有効性が失われることを認識し、よってここに上記のごとく宣言を致します。

I hereby claim foreign priority under Title 35, United States Code, Section 119 (a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Priority Not Claimed

優先権主張なし

14/01/1999

(Day/Month/Year Filed)

(出願年月日)

(Day/Month/Year Filed)

(出願年月日)

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.

| | |
|-----------------------------|------------------------|
| (Application No.) (出願番号) | (Filing Date) (出願日) |
|-----------------------------|------------------------|

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of application.

| |
|---|
| (Status: Patented, Pending, Abandoned) (現況: 特許許可済、係属中、放棄済) |
|---|

| |
|---|
| (Status: Patented, Pending, Abandoned) (現況: 特許許可済、係属中、放棄済) |
|---|

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Japanese Language Declaration
(日本語宣言書)

委任状： 私は下記の発明者として、本出願に関する一切の手続を米特許商標局に対して遂行する弁理士または代理人として、下記の者を指名いたします。（弁護士、または代理人の氏名及び登録番号を明記のこと）

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (list name and registration number)

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| | | Yuji Nomura | |
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(Supply similar information and signature for third and subsequent joint inventors.)

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| 第三共同発明者 | 日付 | Third inventor's signature | Date |
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| 第五共同発明者 | 日付 | Fifth inventor's signature | Date |
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| 国 稽 | Citizenship | | |
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| 第六共同発明者 | 日付 | Sixth inventor's signature | Date |
| 住 所 | Residence | | |
| 国 稽 | Citizenship | | |
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(第七以降の共同発明者についても同様に
記載し、署名をすること)

(Supply similar information and signature for
seventh and subsequent joint inventors.)

THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of: **Yuji NOMURA et al.**

Filed: : **Concurrently herewith**

For : **NETWORK-DEVICE CONTROL SYSTEM AND APPARATUS**

Serial No.: **Concurrently herewith**

December 21, 1999

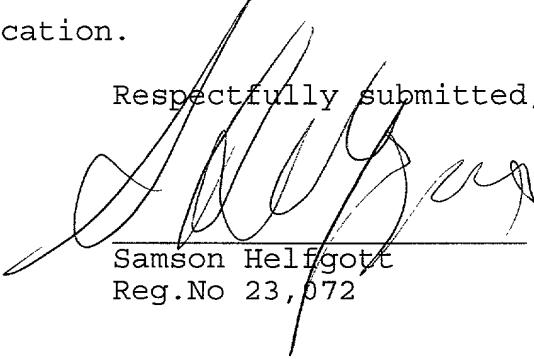
Assistant Commissioner of Patents
Washington, D.C. 20231

SUB-POWER OF ATTORNEY

S I R:

I, Samson Helfgott, Reg. No. 23,072 attorney of record herein, do hereby grant a sub-power of attorney to Linda S. Chan, Reg. No. 42,400, Jacqueline M. Steady, Reg. No., 44,354 and Harris A. Wolin, Reg. No. 39,432 to act and sign in my behalf in the above-referenced application.

Respectfully submitted,


Samson Helfgott
Reg. No 23,072

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By Linda S. Chan

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